SCIENCE

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CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE EARLY PRESIDENTS OF THE AMERICAN ASSOCIATION.**

III.

GOULD.

Gould † was born in Boston in 1824, and was graduated with honors at Harvard twenty years later. He then went abroad and for four years studied under the most distinguished astronomers of Europe, but chiefly under the great Gauss, in Göttingen, where he received his doctor's degree.

In 1848 he returned to Boston, and there —a little more than half a century ago—began the publication of the *Astronomical Journal*, the first and still the only distinct periodical of that science devoted to original investigation in this country.

Then came his valuable connection with the Coast Survey, during which he had charge of the longitude determinations, and subsequent to the laying of the Atlantic cable in 1866, he connected the two continents by precise observations. These first determinations of transatlantic longitude by telegraph were the means of establishing a connected series of longitude measurements from the Ural Mountains to New

* Address of the Vice-President and Chairman of Section I of The American Association for the Advancement of Science, Columbus Meeting, August, 1899.

† See sketch with engraved portrait on wood in *Popular Science Monthly*, Vol. XX., p. 683. March, 1882.

Orleans. In the successful accomplishment of this work he anticipated his English colleagues, and so added greater renown to the advancement of American science.

From 1856 to 1859 he was director of the Dudley Observatory in Albany, and superintended its construction. It was in this building that the normal clock, protected from atmospheric variations and furnished with barometric compensation, was first used to give time telegraphically to dials throughout the observatory; indeed, as improvements of his own suggestion were established, the service was extended until it was that clock that gave the time signals to New York. The three years of his valuable services to science at Dudley were marred by a famous controversy, the discussion of which cannot be taken up here. It had to do with the important question as to whether the wishes of a board of trustees should be carried out by a scientific director. Gould absolutely declined to accept the dictates of those who determined to compel him to adopt a policy which was opposed to that which he regarded as best for the scientific development of the observatory. Firm in his belief as to what was right, he declined to resign, and finally, by process of law, was removed from his directorship. Gould fought his fight bravely and honestly, and though in the end he was unsuccessful, still to his credit it must be said, he never yielded his ground.

The great event of his life was the magnificent work accomplished by him while director of the National Observatory of the Argentine Republic in Cordoba. In 1868 he was called to the organization of the observatory there, and after obtaining from Europe a complete outfit of instruments, superintended the erection of the observatory.

He began work in 1870. Of the work accomplished he said:

> The original purpose was to make a thorough survey of the southern heavens by means of observations in zones between the parallel of 30° and the polar circle; but the plan grew under the influence of circumstances, until the scrutiny comprised the whole region from the tropic to within 10° of the pole—somewhat more than 57° in width, instead of 37°. Although it was no part of the original design to perform all the numerical computations, and still less to bring the results into the form of a finished catalogue, it has been my exceptional privilege, unique in astronomical history so far as I am aware, to enjoy the means and opportunity for personally supervising all that vast labor, and to see the results published in their definite, permanent form.*

It was also under his direction that the Argentine Meteorological Service was established in 1872, and its work he described as follows:

> At the end of the year 1884 there were already twenty-three points at which the observations had been continuously made, three times a day, for at least four years, and sixteen others at which they had already been continued for more than two years. These have provided the necessary data for constructing the isothermal lines, with tolerable precision, for all of South America from the Torrid Zone to Cape Horn.†

His work done, and well done, he came home to pass the evening of his life with the friends and associates of his early years. His return to the United States was celebrated by a dinner, at which those who knew him best, greeted him with glad words of welcome. Holmes wrote for that occasion:

Once more Orion and the sister Seven
  Look on thee from the skies that hailed thy birth—
How shall we welcome thee, whose home was Heaven,
  From thy celestial wanderings back to earth?

* Addresses at the Complimentary Dinner to Dr. Benjamin Apthorp Gould, p. 15.

† Idem, p. 17.

Fresh from the spangled vault's o'erarching splendor,
Thy lonely pillar, thy revolving dome,
In heartfelt accents, proud, rejoicing, tender,
We bid thee welcome to thine earthly home.*

Advancing years came pleasantly to him. In Cambridge he reëstablished the *Astronomical Journal*, the special pride of his early life, and honors, such as are accorded only to the very great, came to gladden him with their special significance of recognition and appreciation. A dozen peaceful years were spent in the quiet of his own home before the end came, and then he passed beyond the stars to his new home in the faraway skies.

The meeting in Chicago brought into conspicuous notice one of the pioneers in American geology, whose fine attainments had been honored locally by his election to the presidency of the Chicago Academy of Sciences. Our Association was quick to recognize the growing advancement of science in the west by electing John Wells Foster to preside over the Salem meeting in 1869.

FOSTER.†

Foster was born in Petersham, Massachusetts, in 1815, and was a lineal descendant of Myles Standish, of Mayflower celebrity. He was educated at Wesleyan University, and then studied law. In the early thirties Ohio was still the El Dorado of New England, and Foster settled in Zanesville, where he completed his law studies and was admitted to the bar.

In 1847 the national government instituted a geological survey of the Lake Superior region, which at that time was attracting much attention, owing to the discovery of the copper deposits there. Charles T. Jackson was appointed in charge of the expedition, and he chose as his assistants Foster and Josiah D. Whitney. On the completion of the work, two years later, the preparation of the report was assigned to the younger men. The two slender volumes were published by Congress, and still remain the accepted authority on the subject of which they treat. It was at the Cincinnati meeting of our Association in 1851, that the elder Agassiz 'declared it to be one of the grandest generalizations ever made in American geology.'

He returned to Massachusetts and was active in politics, serving for some years as one of the Governor's executive council, but in 1848 he again went west, and Chicago became his permanent home. For some years he had charge of the land department of the Illinois Central Railroad and then held a similar connection with the Chicago and the Illinois Central Railroad, and then held a similar connection with the Chicago & Alton Railroad, but he relinquished these appointments to return to the pursuit of science, and accepted a chair of natural history in Chicago.

He was the author of 'The Mississippi Valley, Its Physical Geography,' which gave valuable sketches of the topography, botany, climate and geology of that part of the United States. His last work, published shortly before his death, was on Prehistoric Races of the United States, and gave the results of his investigations of the mounds found in various places in the Western States. He was the editor of the *Lakeside Monthly*, and a frequent contributor to literary and scientific periodicals. It was said of him that "his varied experience, his wide and accurate knowledge of facts, his intellectual comprehensiveness, and discriminativeness made him the peer of the foremost scholars of his time, while his personal and social qualities made him respected and loved by all who came within the radius of his winning personality." He died in 1873.

* Addresses at the Complimentary Dinner to Dr. Benjamin Apthorp Gould, p. 22.

† A portrait of John Wells Foster is published as Frontispiece.

CHAUVENET.

The gathering in the west was succeeded by one in the east, and Troy, N. Y., was selected as the meeting place of our Association in 1870. William Chauvenet was chosen to preside, but as the time came for the gathering of the scientists his health was so precarious, and his end so near, that he was unable to be present, and the vice-president, Thomas Sterry Hunt, occupied the chair. Both names are included in the list of our presidents, and a brief sketch of each is therefore given.

Chauvenet* was born in Milford, Pennsylvania, in 1824, and was graduated at Yale in 1840. The mathematical ability that he had shown while in college led to his prompt appointment as assistant to Alexander D. Bache, who gave him charge of the reduction of the meteorological observations then being carried on at Girard College. A year later, however, in 1841, he received an appointment as professor of mathematics in the United States Navy, and continued in that capacity until 1859. At first he served on board of the steamer *Mississippi*, and later at the Naval Asylum in Philadelphia, but he became greatly interested in the proposed establishment of the United States Naval Academy, in Annapolis, and when that institution became a reality he was transferred there, receiving the chair of astronomy, navigation, and surveying, and was 'always the most prominent of the academic staff.'†

In 1855 the chair of mathematics, and in 1859 the chair of astronomy and natural philosophy, at his *alma mater*, were offered to him, but the rigors of the northern winters he feared would be too severe for his delicate constitution, and he declined to accept either of them. But in the last-named year he was called to the professorship of mathematics in the then recently founded Washington University in St. Louis, and in 1862 he was made chancellor of that university, but two years later failing health compelled him to abandon all active work, and he sought recuperation in travel. In 1865, with apparently restored health, he was able to practically resume his duties, but four years later he was obliged to relinquish them entirely. It was at that time that he was elected to the presidency of our Association, but he was unable to attend the meeting, and in December, 1870, he died in St. Paul, Minnesota. Mention should be made of the fact that he served the Association as general secretary at the Springfield meeting in 1859.

There have been men of extraordinary ability, there have been men of great talents, and there have been famous students who have laboriously worked out important discoveries, among those who have held the high office of president of our Association, but among them all, two only, Hunt and Cope, it seems to me, possessed those brilliant mental qualities which are the natural endowments of genius.

* Biographical Memoirs of the National Academy of Sciences, Washington, 1886, Vol. I., p. 227, William Chauvenet, by J. H. C. Coffin.

† Biographical Memoirs, p. 235.

HUNT.

Hunt* was born in Norwich, Connecticut, in 1826, and was descended from William Hunt, one of the founders of Concord, Massachusetts, in 1635. His maternal grandfather was Consider Sterry, of Norwich, a well-known mathematician and civil engineer in his time. His early education was slight, but as a young man he became laboratory assistant in the chemical

* See *Popular Science Monthly*, Vol. VIII., p. 486, February, 1876, with an engraved portrait on wood. See also sketch with half-tone portrait in *Engineering and Mining Journal*, November 7, 1891, and sketch by R. W. Raymond in that journal for February 20, 1892. The *Scientific American* of March 19, 1892, likewise contains a sketch of Hunt with a half-tone portrait.

department of Yale under the elder Silliman. Seldom has an opportunity been used to greater advantage, and so quickly did he acquire a knowledge of the sciences presented, that after two years in New Haven he was, in 1847, appointed chemist and mineralogist to the Geological Survey of Canada, a place which he then held for exactly a quarter of a century. During that period, with his unusual powers, he presented to the scientific world those remarkable contributions to the twin studies of chemistry and geology that have gained for him a foremost place among the pioneers of the newer science of geological chemistry. His early papers treated of chemistry. He developed a system of organic chemistry in which all chemical compounds were shown to be formed on simple types represented by one or more molecules of water or hydrogen.* He anticipated Dumas with his researches on the equivalent volumes of liquids, and in 1887 published in book form, under the title A New Basis for Chemistry, a full digest of his papers, forming a complete system of his theory of chemistry.

In 1872 he returned to the United States and accepted the chair of geology in the Massachusetts Institute of Technology made vacant by the retirement of William B. Rogers, and remained in that capacity until 1878, after which New York City became his principal home, and he devoted his leisure, until his death, in perfecting his books, which present in matured form the opinions originally published as addresses or special papers. They include Chemical and Geological Essays; Mineral Physiology and Physiography; and Systematic Mineralogy According to a Natural System, and according to R. W. Raymond, 'constitute a monument to his genius, industry, and learning which certainly cannot be overlooked by the historian of science.'"*

*See a Century's Progress in Chemical Theory. *American Chemist*, Vol. V., p. 56, August, 1874.

Three times during the life of our Association has the science of botany been conspicuously honored by the selection of its most distinguished representative to preside over one of our meetings. The first of these occasions was in 1855 when the able Torrey filled the presidential chair with much grace and dignity, and the second was at the Indianapolis meeting in 1871, when Asa Gray was the presiding officer.

GRAY.

Gray† was born in the Sauquoit Valley, in New York, in 1810, and was the son of a farmer. At an early age he showed a greater fondness for reading than for duties around the farm, and his father wisely decided to make a scholar of him. He was sent to school in Clinton, New York, and later to an academy in Fairfield, New York. At the last-named place in compliance with the desires of his father he entered the medical school, and in 1831 received his doctor's degree from that institution. Meanwhile, however, he acquired an interest in natural science, largely through the influence of Dr. James Hadley, the professor of materia medica and chemistry. Farlow says 'he was not at first so much interested in plants as in minerals,'‡ and this is of special interest, for it was about that time that he first met Dana, with whom he ever afterward maintained a close friendship.

* *Engineering and Mining Journal*, February 20, 1892.

† See Memorial of Asa Gray reprinted from the Proceedings of the American Academy of Arts and Sciences, and Biographical Memoirs of the National Academy of Sciences, Vol. III., p. 161, Asa Gray, by W. G. Farlow. See also Letters of Asa Gray, by Mrs. Jane Loring Gray, 2 vols. Boston, 1893; and Scientific papers of Asa Gray, selected by Charles S. Sargent. 2 vols. Boston, 1888.

‡ Memorial of Asa Gray, p. 20.

It is also Farlow who is my authority for the statement 'that his passion for plants was aroused by reading the article on Botany in the Edinburgh Cyclopædia,'* and with a fondness for collecting, we learn that even before graduating 'he had brought together a considerable herbarium.'†

It does not appear that he ever practiced medicine, for during the same year that he graduated he became instructor in chemistry, mineralogy, and botany, in the high school in Utica, and he also lectured on these subjects at the medical school.

In 1833 he went to New York, where he joined Torrey, whose assistant he became, and two years later, through Torrey's influence, he was appointed curator and librarian of the Lyceum of Natural History, now the New York Academy of Sciences. About that time the preliminary arrangements for the Wilkes Exploring Expedition were being made, and the place of botanist was accepted by Gray. It was the fact that his friend Gray had accepted an appointment on the expedition that led Dana to consider favorably an invitation to serve as its mineralogist. However, the departure of the expedition was delayed for some time, and in the meanwhile Gray resigned to accept a closer relationship with Torrey, who sought his association in the preparation of his Flora of North America.

The organization of a great university is in many ways a formidable undertaking, and the selection of its faculty is, perhaps, the most difficult of all the problems that come up for consideration. Some sixty years ago the University of Michigan elected Asa Gray as its first professor of botany. He accepted the honor, but asked that he be permitted first to spend a year abroad in study. The splendid opportunities for settling disputed points in American botany,

* Memorial of Asa Gray, p. 20.

†Idem, p. 20.

as well as the association with many students of science who have since become eminent, was fruitful of rich results, and so it was that on his return the continuation of the Flora demanded his first attention. The young university in the west lost his services, but botany as a science, was the gainer. Later, perhaps, he might have settled in Ann Arbor, but in 1842 an opportunity, such as comes to but few men, came to him when he was invited to accept the Fisher professorship of Natural History in Harvard. At that time 'there was no herbarium, no library, only one insignificant greenhouse, and garden, all in confusion with few plants of value.'* To describe the development of the botanical department of Harvard, as guided by him, would take more space than I can rightly give, and in this case it is not necessary to attempt it, for in the Memorial of Asa Gray, from which much has already been taken, the story is told by his three friends and associates, Goodale, Watson and Farlow, each of whom succeeded to a share of his work. I may, however, say that at the time of his death, in 1888, the herbarium, the largest and most valuable in America, contained over 400,000 specimens, the library had more than 8,000 titles, the 'insignificant greenhouse' had been increased many fold, and the garden had become the most important of its kind in this country.

Like Louis Agassiz, Wolcott Gibbs, Jeffries Wyman, and other of his great contemporaries at Harvard, his influence as a teacher was remarkable, and it was well said of him that 'he trained up a whole race of botanists, now scattered through all parts of the United States.'† Like Dana, his influence was extended by his text-books throughout the English-speaking world. His Elements of Botany, first published in 1836, became later the Structural and Systematic

* Memorial of Asa Gray, p. 26.

† Idem, p. 28.

Botany. The well-known Manual of the Botany of the Northern United States is still a classic. How Plants Grow and How Plants Behave "found their way where botany as botany could not have gained an entrance, and they set in motion a current which moved in the direction of a higher science with a force which can hardly be estimated."*

In conclusion let me quote the words of Dr. J. E. Sandys, of Cambridge, who, in conferring the Degree of Doctor of Science from that famous old University, said:

> This man who has so long adorned his fair science by his labors and his life, even unto a hoary age, 'bearing,' as the poet says, 'the white blossoms of a blameless life,' him, I say, we gladly crown, at least with these flowerets of praise, with this corolla of honor. For many, many years may Asa Gray, the venerable priest of Flora, render more illustrious this academic crown!†

SMITH.

The brilliant work in chemistry done by J. Lawrence Smith, combined with the fact that prior to his election no representative of chemistry had ever been chosen as president of our Association, had doubtless much to do with his selection to preside over the gathering held in Dubuque, Iowa, in 1872. The wisdom of the choice was confirmed early in that year by his election to the National Academy of Sciences.

Smith‡ was born in Charleston, South Carolina, in 1818, and studied civil engineering at the University of Virginia, but preferring medicine, he was graduated in 1840, at the Medical College in Charleston, submitting as his thesis a valuable paper on 'The Compound Nature of Nitrogen.' As was largely the custom in those days, he spent several years in Europe, passing his winters in Paris, where he studied chemistry with Dumas, toxicology with Orfila, and physics with Becquerel, and his summers in Giessen studying with the immortal Liebig. While he was in Paris the celebrated poison case of Madame La Farge occurred, in which the question of the normal existence of arsenic in the human system was involved, and although he was a student under Orfila, he did not hesitate to differ with his master and review the entire question in a paper, in the conclusion of which in after years, Orfila himself agreed. It was in that way that his interest in medicine became subordinate to that of chemistry.

In 1844 he returned to Charleston, where he entered on the practice of his profession, and during the winter delivered a course of lectures on toxicology in the medical college.

The development of mineral wealth in the different states was beginning to be considered an important matter, and in South Carolina Smith's recognized ability and education led to his appointment as state assayer to test the bullion coming into commerce from the states of Georgia and the two Carolinas. This place he accepted, and so relinquished his practice.

It naturally followed that he should devote some attention to agricultural chemistry, and the great marl beds on which the city of Charleston stands attracted his notice. It was he who "first pointed out the large amount of phosphate of lime in these marls, and was one of the first to ascertain the scientific character of this immense agricultural wealth."* Dr. Smith also made a valuable and thorough investi-

* Memorial of Asa Gray, p. 32.

† Asa Gray, by Walter Deane, with an electrotype portrait, *Bulletin of the Torrey Botanical Club*, Vol. XV., p. 70.

‡ Biographical Memoirs of the National Academy of Sciences, Vol. II., p. 217. John Lawrence Smith, by Benjamin Silliman, with a Bibliography. See also Original Researches in Mineralogy and Chemistry, by J. Lawrence Smith, Louisville, 1884. This memorial volume contains several biographical sketches and a portrait of Dr. Smith.

* Dr. J. B. Marvin in Original Researches, etc., p. 10.

gation into the meteorological conditions, character of soils, and culture affecting the growth of cotton.

This work attracted considerable attention, and in consequence he was regarded by James Buchanan, then Secretary of State, "as a suitable person to meet the call from the Sultan of Turkey for scientific aid in introducing into that kingdom American methods in the culture of cotton."* On reaching Turkey he found that a commission was already engaged on the problem of cotton culture, and as he was about to return, the Turkish government invited him to report on the mineral resources of its territory. This work proved most valuable, and his discoveries of emery deposits in Asia Minor destroyed the monopoly then held by the Island of Naxos.

In 1850 he returned to the United States, and for two years lectured on science in New Orleans, and was elected professor of chemistry in the University of Louisiana, an institution which he said "at present exists but in name." Two years later he was called to succeed Robert E. Rogers in the chair of chemistry in the University of Virginia, and then began with George J. Brush that splendid series of analyses of American minerals. Silliman said of them: "They settled many doubtful points and relegated into obscurity many worthless theories, while clearly establishing others."†

His stay at the University of Virginia was a short one, for at the end of the year he resigned and settled in Washington, where he became connected with the Smithsonian Institution as chemist, also devoting some attention to agricultural chemistry for the Department of Agriculture.

Louisville was the home of his wife's family, and the chair of medical chemistry and toxicology in the University of Louisville, made vacant by the resignation of the younger Silliman, was tendered to him in 1854. That place was promptly accepted, and therefore Louisville became his home. For twelve years he continued his professorial duties, and also manifested his fondness for practical chemistry by his acceptance of the charge of the Louisville Gas Works, and by his establishing with the venerable Dr. Edward R. Squibb a laboratory for the production of chemical reagents and the rarer pharmaceutical preparations.

It was during the year that he was connected with the Smithsonian Institution that our Association met in Washington, and for that meeting he prepared his first memoir on meteorites, a subject to which he had become attracted by his purchasing the collection belonging to Gerald Troost, of Nashville. The study of these interesting bodies became thereafter his favorite subject of investigation, and about forty of his papers were devoted to them. He was active in collecting specimens of American falls, and his collection which contained representatives of 250 falls, passed on his death to Harvard University, swelling that collection until it became the best in the country.

His study of meteorites led naturally to his devising improved methods of analysis, especially of the silicates, and while in Paris on one of his many visits there he became interested in the discovery of new elements in the complex mineral samarskite. He devoted much attention to the isolation of its constituents, and at the St. Louis meeting of our association announced the discovery of what he believed to be a new element, to which he gave the name of Mosandrum. The announcement of the isolation of a new element by a past president, gave to the chemical section in 1878, an impetus and dignity that it has never relinquished. Dr. Smith was also present at the Boston meeting, and it was about that time that he further announced his discovery of certain

* Silliman in Original Researches, etc., p. 27.

† Idem, p. 33.

rare earths, for one of which, should it prove to be an element, he proposed the name of Rogerum, in honor of our William B. Rogers.

Our Association has always been fortunate in its permanent secretaries. They have all been devoted to the interests of the organization and two of them held office for many years. The first permanent secretary was Spencer F. Baird, who was chosen to that office at the Cincinnati meeting in 1851, and continued as such until 1854, when he was succeeded by Joseph Lovering, who then filled the place until 1873, when he in turn was succeeded by the present retiring president, Professor Putnam. Lovering's valuable services were recognized by his election to the presidency in 1872, and he presided over the meeting held in Portland a year later.

MARCUS BENJAMIN.

U. S. NATIONAL MUSEUM.

(*To be concluded.*)

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*THE CLASSIFICATION OF BOTANICAL PUBLICATIONS.**

A RECENT number of SCIENCE,† in continuation of the discussion of the proposed international catalogue of scientific literature, to which space has been devoted in that journal for some months past, deals with the question of botany, and the article referred to must be considered as my excuse for the presentation to the Society of the following observations, which are intended solely as suggestions which, in part, may be helpful in starting the botanical portion of the proposed catalogue on lines which are likely to make it of the simplicity, coherence and general usefulness which all desire it to possess.

In the article referred to, Professor Bessey has called attention to a paper prepared by the writer, some years since, for the Botanical Seminar of the University of Nebraska, which was intended to present before that body the results reached in the handling of a rather large library, the purpose of which is entirely botanical, applied botany and the arts based thereon of necessity being included. The subject now under consideration, while fundamentally the same as that handled in the unpublished paper referred to, is, however, practically quite different in the details of its management. In the paper referred to, the problem analyzed was that of the arrangement of a library which, devoted to botany, stood in isolation from other libraries, so that many works were of necessity included in it because of their bearing on botanical subjects, although in title and in some instances in substance not at all botanical. The subject requiring consideration in connection with the proposed catalogue, however, is that of a purely botanical library which may be supposed to stand in the closest possible connection with collections of works referring to all other branches of knowledge—or, stated otherwise, the botanical part of a general library—and is, therefore, in many respects a simpler one. The first mentioned can scarcely be so handled as to meet with the approval of general librarians or of librarians whose subjects are restricted but not botanical, because general knowledge and other sciences are of necessity warped therein that they may be bent to the requirements of the single specialty to which each book which finds a place on the shelves is subordinated. The second, on the other hand, calls primarily for a simple but logical classification of botanical knowledge, with provision for the insertion in it of a relatively small number of non-botanical works which are in such frequent demand as to call for the provision of a special copy

* Read before the Columbus meeting of the Botanical Society of America, and by request of the Society before Section G of the American Association for the Advancement of Science at the Columbus meeting.

† N. S. **10**: 46–8. Jl. 13, 1899.

for the botanical library, in addition to that which would be found on other shelves.

It would at first sight seem quite unnecessary that the classification of botanical knowledge, or, for that matter, of knowledge in any department, for special library purposes, should demand consideration in connection with the preparation of any catalogue or the arrangement of the books on the shelves of any library, since the entire subject and its various parts have frequently been handled by people of large experience; but, as Professor Bessey has shown, the treatment of any specialty, and particularly of one in which development has been rapid and interest limited to a relatively small number of people, by a general librarian, to whom it is of minor importance since it represents only one small fraction of his field, is likely to be unsatisfactory to the student who wishes to enter into its minutiæ, while, on the other hand, the classification of such special knowledge by a specialist is likely to be carried into such detail as to make it too complicated for general purposes.

The scheme which is submitted below is essentially the same as the purely botanical portion of the unpublished scheme referred to by Professor Bessey, with the modification of certain details which are not necessary for ordinary library purposes. While the attempt to adhere to any numerical or similar division of a subject is certain to be attended by so many inconsistencies as to make it undesirable to be biased by it, the convenience of a decimal arrangement is so great that in this scheme several subjects, which are really primary, have been divided so as to make nine principal topics, the subdivision of which, then, has been arranged into such a number of parts in each case as seemed desirable. It is to be understood that in the list subjects which are either mixed or of too indefinite a character to find place under subdivisions will naturally take place under the general division to which they obviously pertain, and in each section the arrangement would be alphabetical by authors. As herein proposed, the scheme of topics would be stated as follows:

BOTANY.*

1. Works of miscellaneous contents, but of botanical interest, and treatises on several branches of botany.
2. Biographies of botanists, and collected writings of miscellaneous contents, whether purely botanical or botanical in part only.
3. Nomenclature, taxonomy and descriptive botany.
4. Morphology and organography.
5. Vegetable physiology, including ecology.
6. Vegetable pathology, including the injuries of plants and therapy.
7. Evolution, natural selection, etc.
8. Man's influence on plants, artificial selection, etc.
9. Phytogeography, floras, etc.

These general topics, for the purposes of any but the most special branch of botany, seem capable of logical subdivision in the way that is indicated below, without introducing a complexity beyond the endurance of anyone competent to handle a general library in which modern science is fairly represented, but any topic represented by only a few works can readily be left undivided until division becomes necessary. Where the number of works becomes too great for convenient handling in any ultimate division as here stated, the specialist, who alone will have occasion to handle a collection of the kind, can readily subdivide to any extent that he may wish; but it should be remarked that beyond the actual needs of subdividing any topic, such

* To bring this scheme into agreement with a resolution of Section G, recommending "as a basis for the classification of a botanical library, the decimal system now in common use in the United States," it is necessary only to designate 'Botany' as 580, and to prefix 58 to each numeral as here used: *e. g.*, 5.111 becomes 585.111, etc.

subdivision had best not be resorted to, since the larger the number of divisions the greater the probability of getting works, by accident, in the wrong class, and the greater the difficulty which the person not a specialist will experience in knowing where to look for any given work, unless the most rigid care is taken in shelf-marking the catalogue cards to the last degree.

BOTANY.

1. Works of miscellaneous contents, but of botanical interest, and treatises on several branches of botany.
 1.1 General treatises containing more or less matter of botanical interest, when these find place on the botanical shelves.
  1.11 Publications of societies, colleges, museums, etc.
   1.111 Botanical gardens, parks, etc.
  1.12 Journals, excepting those restricted to some single branch of botany.

These three classified geographically. In the library referred to, the geographical sequence used is that of Dewey's classification, and the numerals adopted to indicate it are the essentials of his geographical numerals as arranged, for example, under his 938–939, beginning with 38–9 Circum-Mediterranean region, including more than one continent, 40 Europe, to 99 Antarctic region, the minuteness of the subdivision of any given geographical area being made to conform to the number of works on that area possessed by a given library. It is evident, however, that the sequence adopted by Dewey is by no means a satisfactory biological sequence, and, were his system not in very considerable use, it would be far better to arrange a more logical sequence.

  1.13 Text-books, lecture-outlines, etc.

Those restricted to special subjects would be sought under such subjects.

 1.2 Dictionaries and encyclopædias.
  1.21 Language dictionaries.
  1.22 Encyclopædias, technical dictionaries.
  1.23 Nomenclators, dictionaries of plant names, and purely botanical encyclopædias.

Botanical encyclopædias which are in the nature of synopses of the vegetable kingdom or certain of its parts would be sought in the special group, treated under Taxonomy.

  1.24 Bibliographic aids of general contents.
  1.25 Indexes to illustrations and exsiccatæ.
 1.3 Icones.

A convenient class for botanical gardens and the like, but, when used at all, comprising works which would generally be distributed among monographs, floras, journals, etc., with greater propriety.

 1.4 Popular and economic botany.
  1.41 Botany of literature.
  1.42 General and miscellaneous economic botany.
   1.421 Botany of agriculture.

Revisions of special groups of economic plants pertaining to this and the following entries might also be sought under Taxonomy.

   1.422 Botany of horticulture.
    1.4221 Fruits.
    1.4222 Vegetables.
    1.4223 Decorative plants.
   1.423 Botany of forestry.
    1.4231 Dendrologies, sylvas, etc.

Local floras would also be consulted.

     1.42311 Winter manuals.

Other seasonal manuals, seedling manuals, etc., may be arranged as other subdivisions of 1.4231, if desired.

    1.4232 Anatomical classification of woody plants.
     1.42321 Strength and properties of timber.
   1.424 Botany of pharmacy, food adulteration, etc.
    1.4241 Poisons and toxicology.
    1.4242 Mechanical effects of vegetable substances.
    1.4243 Histological pharmacognosy.

2. Biographies of botanists, and collected writings of miscellaneous contents, whether purely botanical or botanical in part only.

3. Nomenclature, taxonomy and descriptive botany.

Under one or more of the divisions of this group it may be convenient to insert subdivisions for journals, proceedings of societies, etc.

 3.1 Spermatophytes (Phanerogams).

The orders in numerical sequence, after Durand or Engler and Prantl.

According to the needs of different libraries a greater or less withdrawal of works from this group, for distribution under Ecology and other heads, is to be expected. Memoirs on fossil plants would find place here. Geological and geographical considerations would go under local floras or Ecology if placed on the botanical shelves.

3.2 Pteridophytes.

Subdivided after Engler and Prantl when desired.

3.3 Bryophytes.

Subdivided after Engler and Prantl in case of need.

3.4 Thallophytes.

Algæ, lichens and fungi are best recognized in a library arrangement, since no other scheme of classifying the thallophytes has yet led to the production of any considerable amount of literature based on such scheme.

3.41 Algæ and Characeæ.

3.42 Fungi.

3.421 Lichens.

3.422 Fungi in the restricted sense.

In some libraries this group will require division numerically, according to Saccardo's Sylloge or Engler and Prantl.

3.423 Yeasts and alcoholic fermentation.

3.424 Bacteria, germ diseases, etc.

3.425 Mycetozoa.

4. Vegetable morphology and organography.

4.1 External morphology, classification and description of plant members.

4.11 Morphology proper.

4.111 Thallus.

4.1111 Root.

4.1112 Shoot.

4.11121 Stem.

4.11221 Leaf.

4.1113 Types of branching.

4.11131 Inflorescence.

4.1114 Flower.

4.11141 Receptacle.

4.11142 Perianth.

4.111421 Calyx.

4.111422 Corolla.

4.11143 Andrœcium.

4.11144 Gynœcium.

4.1115 Fruit.

4.11151 Seed.

4.1116 Appendages.

4.11161 Trichomes, prickles, etc.

4.11162 Sori, sporangia.

4.11163 Archegonia.

4.11164 Antheridia.

4.11165 Embryo sac., etc.

4.11166 Pollen, pollen plants.

For this entire subject Anatomy, Physiology, and the several groups under Taxonomy, would be consulted. Subdivisions may easily be made when required.

4.12 Embryology.

With frequent reference to development, germination, etc.

4.13 Organography.

Subdivided like Morphology.

4.131 Nomenclature of color as applied to plant description.

General treatises on color would, of course, be sought under physics.

4.2 Vegetable anatomy and histology.

4.21 Laboratory manuals, technique, microscopy, photomicrography.

Subdivided if necessary.

4.22 Cytology.

4.221 Cytology.

4.2211 Protoplasm.

4.2212 Plastids.

4.2213 Nucleus.

4.222 Cell contents.

4.223 Cell wall.

4.23 Histology of plant members.

Subdivided at will, like 4.11.

4.231 Histological classification of plants.

See also Botany of forestry, Botany of pharmacy, Taxonomy.

4.3 Teratology.

Deformities and injuries caused by insects, fungi, etc., would be sought under these heads, and under Vegetable pathology.

5. Vegetable physiology.

5.1 Physiology proper.

5.11 Vegetative processes.

5.111 Absorption and conduction of fluid.

Dew plants, rain plants, carnivorous plants, etc., would be sought under Ecology.

5.112 Transpiration.

The phenomena of so-called frost plants, etc., also conveniently classed here; the protective function of stomata, perhaps, under Ecology.

5.113 Plant food, nutrition.

5.1131 Photosynthesis.

5.1132 Metabolism, respiration, secretion.

5.1133 Nutrition.

5.114 Growth, protoplasmic activity.

5.1141 Turgescence.

5.1142 Growth.

5.11421 Circumnutation.

5.1143 Development.

5.1144 Cell division.

Much cytological matter, of necessity, under histology.

5.1145 Protoplasmic movements, irritability.

5.11451 Heliotropism, geotropism, hydrotropism, etc.

See also growth.

5.1146 Germination.

See also 4.11151, 4.12, and 5.1143.

5.12 Reproductive processes.

5.121 Vegetative propagation.

Subdivided, when desired, either on morphological lines or by plant groups. Morphology, Organography and Ecology would be frequently consulted here.

5.122 Sexual reproduction.

5.1221 Differentiation of sex.

5.1222 Heterospory, alternation of generations.

5.1223 Fecundation.

5.1224 Reproduction of Thallophytes

5.12241 Conjugation.

5.12242 Oophytic fertilization.

5.12243 Carpophytic fertilization.

5.1225 Reproduction of Archegoniatæ.

5.12251 Bryophytes and Pteridophytes.

5.122511 Antherozoids.

5.122512 Egg cells.

5.12252 Gymnosperms.

Subdivided like preceding.

5.1226 Reproduction of Siphonogamæ.

5.12261 Pollen and pollen plants.

5.12262 Ovules.

General morphology, Embryology, and Germination, to be consulted.

5.2 Ecology.

5.21 Vegetative interrelations.

5.211 Phenology.

5.212 Nutritive adaptations.

5.2121 Plankton, aquatics, ice plants, dew plants, etc.

5.2122 Climbing plants.

5.2123 Carnivorous plants.

5.2124 Parasites, symbionts.

5.213 Protective adaptations.

5.2131 Compass plants, epiphytes, halophytes, xerophytes, sleep of plants, etc.

Chloroplast movements and the protective adjustment of stomata would be sought under Physiology proper. This may be subdivided as needed.

5.2132 Spines, secretions, raphides.

See also 4.11, 4.222, and 5.1132.

5.2133 Myrmecophilism, acarophilism.

5.22 Reproductive interrelations.

5.221 Pollination.

5.222 Dissemination.

6. Vegetable pathology including the injuries of plants, and therapy.

7. Evolution, natural selection, etc.

8. Man's influence on plants, artificial selection, etc.

Economic botany would be consulted here.

9. Phytogeography, floras, etc.

9.1 Geographical botany.

Ecological considerations would be sought under Physiology.

9.2 Floras.

Subdivided, according to abundance in each area, geographically like periodicals, etc. Travelers' journals of restricted scope, and similar works directly or indirectly throwing light on a local flora, reports of geological surveys, and even local maps and guide books, in a botanical library are brought together here for convenience in use. Fossil floras excluded from taxonomy would find place here.

WILLIAM TRELEASE.

MISSOURI BOTANICAL GARDEN.

ON THE CAUSE OF DARK LIGHTNING AND THE CLAYDEN EFFECT.

I HAVE been criticized in a letter which appeared recently in *Nature* for not alluding in my letter on dark lightning to the peculiar photographic reversal known as the Clayden effect. I must confess that at the time of writing my letter I was unaware of this effect, a description of which has only appeared, so for as I know, in one of the photographic journals. Mr. Clayden has certainly explained dark lightning, and it only remains to explain his explanation. As I think that this effect is not generally known, I believe that it may be worth while to devote a few words to the statement of the case, before describing the experimental work by which I have determined the factors which play a part in this very curious photographic phenomena.

Mr. Clayden showed that if a plate, which had received an impression of a lightning flash or electric spark, was subsequently

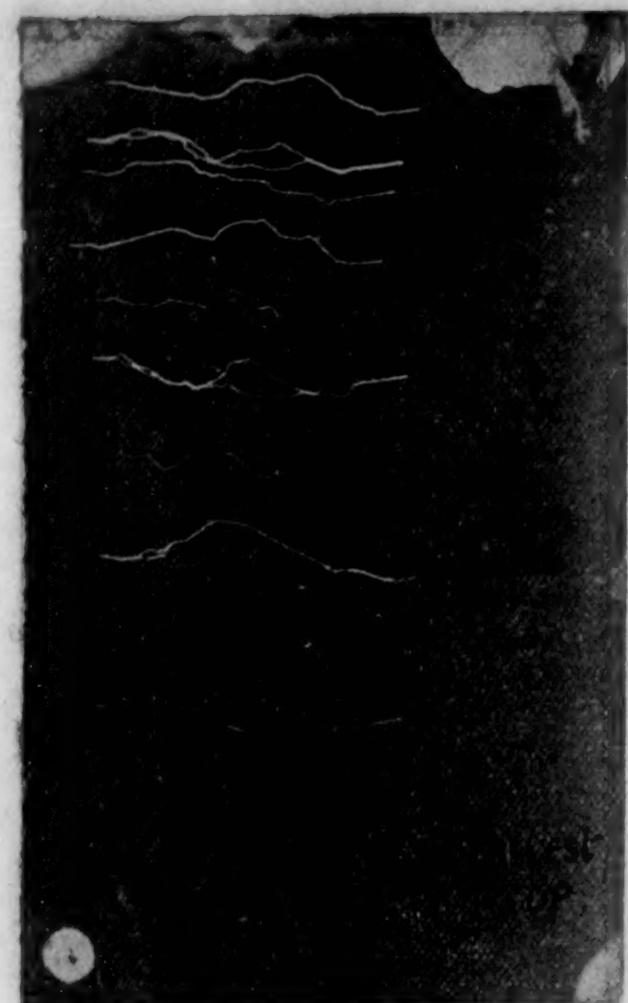

FIG. 1.

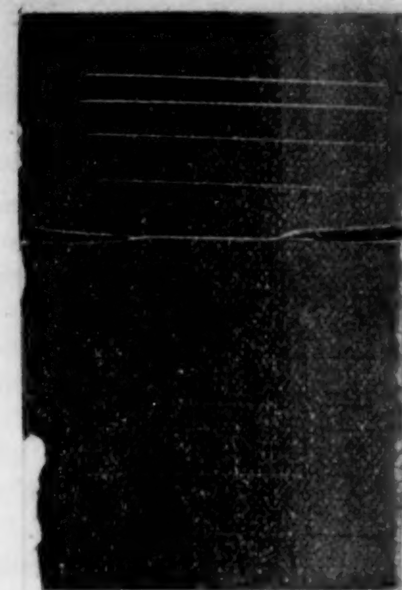

FIG. 3.

FIG. 4a.

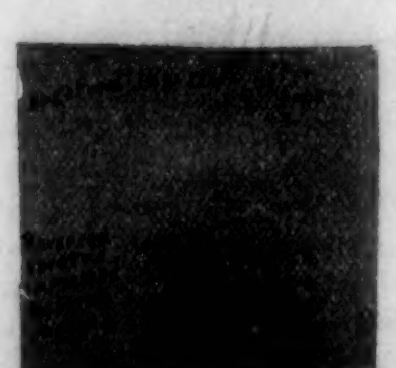

FIG. 2.

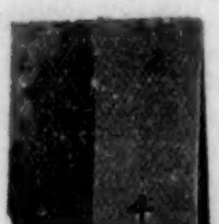

FIG. 4b.

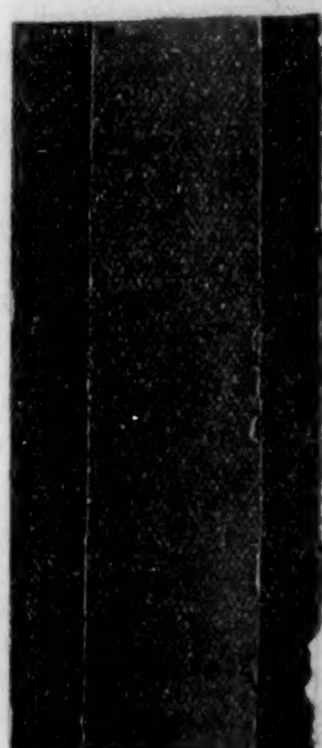

FIG. 5.

slightly fogged, either by exposing it to feeble diffused light or by leaving the lens of the camera open, the flash on development came out darker than the background. If, however, the plate was fogged before the image of the flash was impressed, it came out brighter than the background, as in the ordinary pictures of lightning. I refer to the appearance in the positive print in each case. This is quite different from ordinary reversal due to the action of a very intense light, for the order in which the lights are applied is a factor, and the phenomenon lies wholly in the region of under exposure. I repeated Mr. Clayden's experiment, and obtained dark flashes without any difficulty.

The effect cannot, however, be obtained by impressing an image of a filament of an incandescent lamp on a plate and subsequently fogging the plate. Clearly there is something about the light of the electric spark which is essential to the production of the reversal. It is not intensity, however, for I found it was impossible to obtain reversed images or bright sparks with the lens wide open.

Fig. 1 shows a series of spark images, some normal, some partly reversed and others wholly reversed. The sparks are those of a large inductorium, with a good sized Leyden jar in circuit. The sparks were all of equal intensity, but after each discharge the iris diaphragm of the lens was closed a little. It will be seen that the borders of the bright sparks are reversed. In some the image is reversed with the exception of a narrow thread down the core. The images were impressed in succession on the plate by moving it in the camera. A plate holder was dispensed with, an opening being made in the ground glass back by removing a strip a few centimeters wide. The plate was held against this opening and a large number of exposures made in a few moments. Of course, the room was in total darkness. After exposure the plate was exposed to the light of a candle for a second or two and then developed.

In this series of pictures it will be seen that the edges of the bright images of the sparks are reversed, the intensity on the border of the image being less than at the core. As the intensity of the spark becomes less and less, the bright central core dwindles down to a mere thread and eventually disappears, the spark's image being feeble enough to reverse over its entire area.

This explains why the dark lightning flashes are usually ramifications of the main flash. The ramifications are less brilliant discharges and reverse, while the main one is too bright to cause the effect.

The first thing that occurs to one is that it may be some peculiar radiation which the spark emits, which is wanting in the light coming from other bodies. If a small photographic plate is partly screened by a piece of black paper and illuminated by the light of a small spark at a distance of two or three feet, and a similar plate, screened in the same manner, is illuminated for a moment by candle light of sufficient intensity to produce the same amount of blackening on development, we shall have the means of showing that the spark light differs in its action on the plate from that of the candle. If these two plates before development be half screened in a direction at right angles to the former one, and exposed to the light of a candle for a second or two, the part of the plate which has been illuminated by spark light plus candle light, does not become as black on developing as the part which has only received candle light, whereas the part which has twice been exposed to candle light is blacker than that which has been only exposed once. This shows that the light of the spark does not act in the same way as the light of the candle. Wherein does it differ? It seemed possible that the

peculiarity lay in the nature of its radiation. To test this a prism was placed before the lens of the camera which broke up the image of the spark into a series of spark images of different color. The plate was exposed to the spectrum flash of a single spark, then removed from the camera and exposed to the candle light, and developed. If the reversing effect was due to any peculiar radiation or wave length, we should find the reversal at the part of the spectrum where the effective radiation belonged, say in the infra red, if the reversing power lay in long waves given out by the spark. It was found that the entire spectrum came out lighter on the negative than the fogged background. A second plate was exposed to the spectrum flash, then slightly fogged, and a second spectrum impressed on it. On developing one spectrum came out light and the other dark, as shown in Fig. 2. Clearly the effect does not depend on wave length. It then occurred to me that the time element might enter into the problem. The light of the spark is over in about 1/50000 of a second and it did not seem impossible that a bright light of exceeding short duration might act quite differently on a plate from a weaker light of longer duration. This may be tested in a variety of ways. We may open the lens wide, impress the image of a single spark on the plate, and then stop the lens down and superimpose a number of spark images sufficient to make the total exposure the same in each case. This was the first method which I tried. In order to compel the successive sparks to pass over the same path, that their images might be superposed, I shut them up in a capillary tube. With the lens open wide enough to give the maximum reversing action, I passed a single discharge through the capillary. Stopping the lens down to one-quarter of its former aperture, four discharges were passed through the tube. The plate was then fogged in the usual manner, and on development the single discharge was reversed, but the composite one was not.

Fig. 3 is from a plate showing this effect. The upper images are those of single discharges through the capillary, with different apertures on the lens; the lower images are those of double or triple discharges through the same tube. The left hand side of the plate was exposed to the candle light for different amounts of time, by moving the screen over small distances during the exposure. Only the single discharges reverse, though the density of the images on the unfogged portion of the plate is the same. This is very strong evidence that the duration of the illumination was the important factor.

Some years ago I measured the duration of the flash of the exploding oxy-hydrogen, finding it about 1/12000 of a second. Possibly the flash of such an explosion would duplicate the effect. I exploded several glass bulbs filled with electrolytic gas, but found that the action was the same as that of ordinary light, it being impossible to get any reversal. The flash evidently lasted too long, or there still remained some undiscovered factor.

The difference between the action of spark light and the light of the oxy-hydrogen flash is shown in Fig. 4. Plate 'a' shows the effect of the explosion flash. Squares 1 and 2 received the light from an exploding bulb, the rest of the plate being covered. Squares 1 and 3 were then exposed to the light of the candle. Square 1, which has received the light from both sources, is the brightest, that is, the effects are additive, there being no reversal. Plate 'b' shows the action of the light from the spark. Squares 1 and 2 were illuminated by the spark light, then squares 2 and 4 were exposed to the candle. In this case square 4, which was illuminated by the candle, is brighter than square 2, which received both the spark light and candle

light. In this case the effects are not additive, there being reversal.

To demonstrate conclusively that the time factor was the only one, it was necessary to secure an illumination independent of the electric spark, and of as short duration. This was accomplished in the following manner: A disc 30 cms. in diameter was furnished with a radial slit one millimeter wide near its periphery, and mounted on the shaft of a high speed electric motor. A second slit of equal width was arranged in a horizontal position close to the rim of the disc, in such a position that the two slits would be in coincidence once in every revolution. This second slit was cut in the wall of a vertical chute down which a photographic plate could be dropped. By means of a large convex lens of short focus an image of the crater of an arc-lamp was thrown on the point of coincidence of the slits. The intensity of the illumination transmitted by the slits when in coincidence was almost sufficient to char paper. The motor was then set in motion and a plate dropped down the chute. On developing this plate three images of the slit appeared, not at all overexposed, though the plate was the fastest on the market, and the intensity of the light while it lasted comparable to that at the focus of a burning glass. By measuring the distance between the images and the vertical distance through which the plate had fallen, it was an easy matter to calculate the speed of rotation, which was found to be 60 revolutions per second, the air friction of the disc preventing higher speed. The duration of the exposure will be the time occupied by the rim in traveling a distance equal to the width of the slit or 1 mm. This was found to be 1 / 55000 of a second about that of the spark. The crucial experiment now remained. A second plate was dropped and before development was exposed to the light of the candle. *The images of the slit were most beautifully reversed* except at the center where the light was too intense. A print from this plate is reproduced in Fig. 5. It seems then that we are justified in assuming that *the action of an intense light on a plate for a very brief time interval decreases the sensitiveness of the plate to light.* It is curious to contrast with this effect the fact that exposure to a dim light for a moment or two appears to increase the sensibility by doing the small amount of preliminary work on the molecules, which seems to be necessary before any change can be effected that will respond to the developer. I am not prepared to say what the nature of the change effected by the flash is. Possibly some one familiar with the theory of sensitive emulsions can answer the question. I have tried using polarized light for the reversing flash, and then fogging one-half of the plate with light polarized in the same plane, and other half with light polarized at right angles to it. As was to be expected there was no difference in the effects.

R. W. WOOD.

PHYSICAL LABORATORY OF THE UNIVERSITY OF WISCONSIN, MADISON, Oct. 20, 1899.

ARCHITECTURAL PLANS FOR THE UNIVERSITY OF CALIFORNIA.

THE Phoebe A. Hearst International Competition for an Architectural plan for the University of California was closed on September 7th by the awarding of five prizes for the best plans. The first prize was awarded to M. E. Bénard, of Paris; the second to Messrs. Howells, Stokes & Hornbostel, of New York; the third to Messrs. Despradelle & Codman, of Boston; the fourth to Messrs. Howard & Cauldwell, of New York, and the fifth to Messrs. Lord, Hewlett & Hull, of New York.

From the outset of their inspection, the judges were attracted to the drawings which proved, after the awards had been made, to

be those of M. Bénard. The jury had laid down four propositions for their guidance in the determination of the relative merits of the plans. These propositions were:

1st. That the buildings should represent a university rather than a mere architectural composition.

FIG. 1.—Perspective view of the plan for the University of California.

2d. That there should be a convenient grouping of the educational sections without undue crowding or prevention of possible future expansion.

3d. That the purpose of the several departments should be clearly defined in the design.

4th. That the architectural forms should be adapted to the configuration of the grounds and to the preservation of their natural beauties.

Judged by these standards M. Bénard's plan seemed to possess unquestioned superiority. Its great general beauty, its variety yet harmony of detail, its adaptability to the site, its convenience of arrangement, its flexibility and alterability in respect to individual buildings and to minor matters, and withal its permanent establishment of the great lines of its construction, placed it preëminently above all others. The jurors were unanimously of the opinion that it fulfilled nearly every requirement that might be demanded.

The site of the University at Berkeley, which the architect might utilize, comprises some three hundred acres of land, rising at first in a gentle and then in a bolder slope from a height of about two hundred feet above the sea level, to one of over nine hundred feet. Its greatest length is east and west. The southeast corner has a grove of beautiful indigenous oaks and laurels. Two brooks, which meet in this grove, come the one from the southeast, and the other from the northeast. Along the lines of these streams are native trees, principally laurels and live oaks. The eastern limit consists of a plateau of nine hundred feet elevation. Behind this rises a range of hills, which a mile further back reaches an altitude of nearly two thousand feet.

M. Bénard's plan preserves the park in the southeast corner intact. Adjoining this on the north is his group of buildings for the fine arts, formed around what he calls

Fine Arts Square. These buildings are the Academy of Music at one corner; the great Auditorium or Hall of Ceremonies, at the second corner; the smaller Auditorium, or Lecture Hall or Theatre, at the third corner; and at the fourth corner the School of Fine Arts. Between the School of Fine

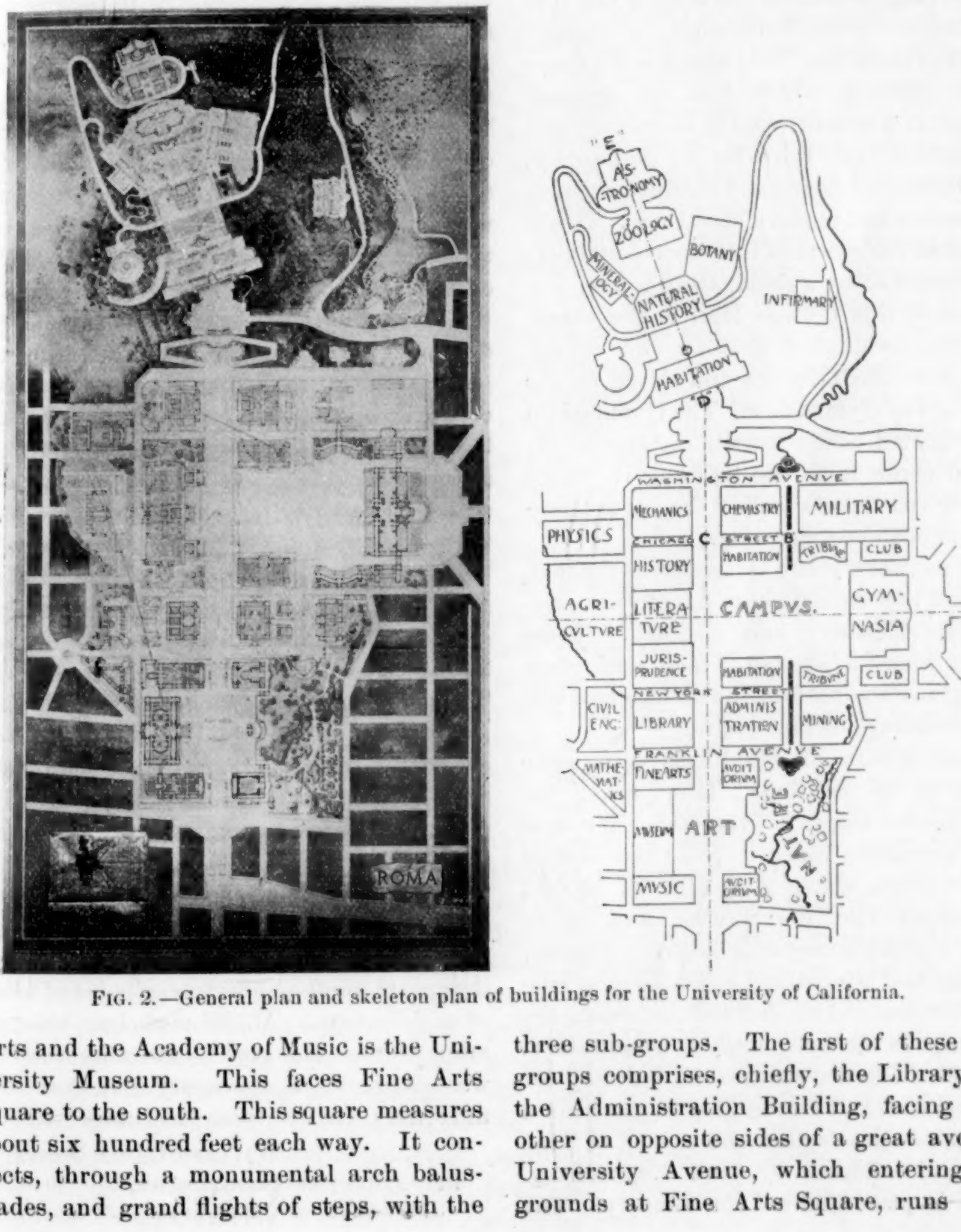

FIG. 2.—General plan and skeleton plan of buildings for the University of California.

Arts and the Academy of Music is the University Museum. This faces Fine Arts Square to the south. This square measures about six hundred feet each way. It connects, through a monumental arch balustrades, and grand flights of steps, with the natural park. The Museum is the most beautiful building in the entire scheme. Fine Arts Square, with its buildings of a public nature, occupies the position most accessible to the town and trains.

Lying east of this group is the great group of educational buildings, divided into three sub-groups. The first of these sub-groups comprises, chiefly, the Library and the Administration Building, facing each other on opposite sides of a great avenue, University Avenue, which entering the grounds at Fine Arts Square, runs east-

ward till it reaches the steep ascent of the hills. The Library and Administration Buildings thus form a connection between the more public and the more private portions of the University.

The next sub-group is comprised of the principal college buildings, which we may call the College Hall or the Hall of the Humanities, two of the dormitories, the campus and the gymnasium. This occupies the space on the grounds which has the greatest breadth. It is monumental in character. The vast College Hall provides for philosophy, jurisprudence, history and political science, and ancient and modern literatures. This is treated as the centre of intellectual activity, and is marked by a dominating tower.

South of this College Hall is the extensive campus flanked first by two dormitories, then the Tribunes and closed on the south by the Gymnasium. The Gymnasium has attracted much attention, because M. Bénard chose it as the building in which to show the details called for in the programme of the competition.

The next sub-group lying east of the last, contains the departments of physics, mechanics, chemistry and military. These stretch along a plateau which will place them above the roofs of the college hall and other buildings of that group.

These groups of buildings, with some others to be mentioned later, cover the more gentle slopes of the site. We now come to a steep ascent. Near the bottom of this slope, above a garden, M. Bénard has placed two dormitories, and above these, a group comprising Zoology, Botany, Geology and Mineralogy and a Natural History Museum. And above all, crowning the landscape is the Astronomical Observatory.

In M. Bénard's scheme the building for Mathematics and Draughting is placed in a triangular spot behind the School of Fine Arts and adjacent to Civil Engineering, which is placed behind the Library. The Mining Building balances the Civil Engineering, by being placed behind the Administration Building. The Agricultural Department is placed in a field north of the main College Hall and increases the breadth of that magnificent group.

Now, it is to be said, that the location of the scientific departments will require in many cases to be changed or transposed. As they stand they indicate a fine conception on the part of M. Bénard, surrounding, buttressing and extending the educational domain. But he had naturally failed to observe the connection of related departments. Owing, however, to the flexibility of the plan, there will not be the slightest difficulty in making the modifications required.

Every building in the whole scheme is designed with a view to its use. The exterior architecture is simple or more or less ornate according to the purpose of the building. Each one asserts its identity by its appearance. Interiorily, again, they are arranged with the utmost precision in the ways indicated by the program. Lecture hall, laboratory, corridor, class-room, study, are all brought into proper relation.

With all the great number of buildings, and the size of them, there is no crowding. The two large spaces, the natural park and the campus, attest this. Besides, there are great longitudinal avenues, each with four rows of trees, and a third parallel avenue, four main cross avenues and numerous smaller streets and walks. The circulation is complete. Foliaged nooks and gardens abound. The whole scheme looks as free and open from a point of view of nature as it appears monumental from a point of view of architecture. M. Bénard has kept in mind, or has conceived unalterably, that he was designing a university, but that this university was a City of Learning.

William Carey Jones.

Department of Architecture,
University of California.

THE FOSSIL FIELD'S EXPEDITION TO WYOMING.

IN June last, the Union Pacific Railroad Company issued a large number of invitations to colleges, universities and museums doing work in geology, to participate in an exploring and collecting tour through the fossil fields of Wyoming, long famous for their remains of various extinct vertebrates. Free transportation was furnished by the railroads from Chicago and return, as well as from other northern and southern railroad centers, to Laramie, Wyoming. At Omaha, Mr. A. Darlow, for the Union Pacific Railroad Company, bade all welcome, looked after the comfort of the guests, and accompanied the expedition to Laramie. The party began to arrive in the latter place July 19th, that day being spent in the election of officers, and in the final preparations for camp life. In the evening, the élite of the university City of Wyoming gathered at the University, where President Smiley extended a cordial welcome to all.

Professor Wilbur C. Knight was elected president and director of the expedition. Wagons, tents, bedding, provisions, and other necessary articles for camping were furnished the members, and, as it afterwards proved, at less than the actual cost. The 'outfit' moved out of Laramie, July 21st, and consisted of 19 two-horse wagons and a few saddle horses, thus providing transportation for 85 men. The party was composed of 66 geologists, paleontologists, botanists, photographers and reporters, with 19 teamsters. Seven of the latter also officiated as 'camp cooks,' each of them purveying to a mess including generally 10 persons. The newspaper men were the first to drop out, and after the North Fork of the Platte River was reached, a little over twenty days out, the expedition was reduced to 14 men. These completed the tour of forty days, as originally planned by Professor Knight, and had a most profitable and enjoyable trip. During these 'forty days in the Wilderness,' we traveled upwards of 300 miles over the treeless, sagebrush plains of eastern Wyoming, and made 18 camps, sometimes besides an alkaline lake, but oftener by a small spring or stream. In this arid region it rained frequently during the first four weeks, and though the rains were generally light they greatly surprised us. On July 23d, we had a snow-balling and alpine flowers in the Medicine Bow Mountains, at an altitude of about 9,000 feet; while on August 11th and again on the 24th, ice formed.

Thirty-two institutions of learning and research, from California to Massachusetts and from Minnesota to Texas, were represented in this expedition which offered so great an opportunity for geological observavation and study. Here could be seen plains 6,000 feet or more above sea level, some almost smooth and others more or less dissected, or several one above another all with the original bedding disturbed and tilted at an angle of from 10 to 30 degrees. Above these, in the distance, lay the Tertiary plateau, which to the eye is an absolute plain abutting against the granite mountains. Here and there over these plains are lakes, usually more or less alkaline, some without outlets produced by the solvent action of water percolating through the strata. At this great altitude could also be seen sluggish meandering streams with closely adjoining horse-shoe curves, the equals of any near the sea level. Towards the mountains the strata gradually stand more and more vertical in series, like so many stone walls, with the dike-cut granite not far away. On the plains, wind action could also be studied, sometimes in the linear arrangement of the sage brush, but frequently in the general polish and occasional faceting of surface pebbles and boulders. In general, the opportunity for studying geology could hardly be surpassed,

since much of Wyoming is one continuous exposure. After seeing this country, it becomes easy to understand how it was possible for a party of the Hayden Survey to prepare, in one field season, a reconnaissance map covering as many as 20,000 square miles.

The most interesting region of the trip, from a picturesque and geological standpoint, was that about the Grand Canyon of the North Platte. We first saw this from the high sage-covered Tertiary crest at 6,800 feet. Back of us were the rounded Indian Grove Mountains of granite, while long and dark Ferris Mountain stood on our left across the river. Directly in front was spread before us, like a painted stereoptican projection, the Grand Canyon country of the North Platte. The hills here have their escarpment directed towards the west, and are superposed like tiles on a roof. Beginning on our left were granite hills followed by those of Carboniferous, Triassic and Jurassic age, in places partially repeated, and all surmounted by the thick Tertiary lake beds. The colors of this panorama were pronounced and pleasing, especially when freshened by a rain, as when we first saw them. The brick-red color of the Triassic contrasted strikingly with the light green of the Jurassic and the browns of the Tertiary passing upwards into ash-colored beds. Hidden in this picture across the strike was the Grand Canyon of the Platte, eight miles long and in places nearly 1,000 feet deep. Over to the right may be seen the silver thread of the river issuing and flowing through the open country, but it is soon lost to view in the Little Canyon, which is 400 feet deep and about half a mile in length. Both gorges have perpendicular right-angled walls, and are very narrow, so narrow in places that a stone can be tossed across. Only one party is known to have gone through the Grand Canyon of the North Platte. This consisted of Freemont with Mr. Preuss and 'five of my best men,' Canadian voyageurs, who started in a canvas boat, August 24, 1842. The passage was extremely dangerous, and finally, at the foot of a fall, the boat was whirled over and men and baggage were thrown into the raging stream. Luckily no one was drowned, but most of the baggage was lost. In the Little Canyon, which is through a faulted ridge, there is a large hot spring that contains light-green algæ. This water is now piped half a mile to Alcova, where a pioneer has a primitive 'Hot Springs Resort' fifty miles from a railroad.

Another very interesting region was Bates' Hole, a narrow hole-like valley in Tertiary strata with a maximum depth of 1,500 feet. It is drained by Bates' Creek, a tributary of the North Platte, near Alcova. The lower level is in a series of delicately tinted yellow, red, green, and whitish Eocene shales and soft sandstones. Above, along the margin of the Hole, are the Titanotherium beds of the Lower Miocene, which are picturesquely castellated, series above series, in places 400 feet or more high. This constitutes another style of 'Bad Land' scenery. Here Professor Knight made use of an unusual method for ascertaining the time required for the erosion of Bates' Hole. The marginal slopes are often very steep, and upon them are growing isolated slowly dying pines perched by their roots from one to three feet above the present surface. Since the annual growth rings of the trees will indicate their age, a time measure is at hand for the amount of strata removed from beneath the tree. This, when taken in connection with the size of the Hole, will give some idea as to its age. A provisional estimate places it at 1,584,000 years since the close of Miocene time. (See SCIENCE, for October 27, 1899.)

Several tons of good fossils, mainly invertebrates, were collected during this trip.

Many of the members also expected to secure a Dinosaur each, but the magnitude of the work soon changed enthusiasm into regret. In the very beginning, alarming setbacks are encountered when climbing the hills in any direction for a 'bone lead.' Having the good fortune to discover one, the real work then begins in the digging, only to find that every bone is cracked into innumerable pieces. These must be bandaged and set in plaster, and when all is hard the bones can be turned to undergo more bandaging. This means that one must have patience, be expert with pick and shovel, with gunny sacking and plaster, and with saw and hammer. However, with all these difficulties to overcome, no less than six car loads of bones were shipped this summer from Medicine Bow, a little village on the Union Pacific Railroad in Wyoming, by specially organized parties from the Universities of Wyoming and Kansas, and the Field, Carnegie and American Museums of Natural History.

In no one place are complete Dinosaur skeletons found. Sometimes a 'quarry' will yield a lot of vertebræ, or a number of either hind or fore limbs, or there is a general mixture of parts of animals of different genera. To make an adequate collection of Jurassic Dinosaurs, therefore, requires several successful field seasons. The cost is still further enhanced since in the laboratory the bones must be cleaned, hardened and restored before they are ready for study and exhibition. On account of these conditions and the further one that Dinosaur skeletons are very large, the work is extremely expensive. We can, therefore, believe that the best skeleton of Brontosaurus in Professor Marsh's collection, an imperfect one, cost him $10,000.

The wonderful newspaper stories of last spring about the finding of a Dinosaur indicating a length of 130 feet is the prize paleontological story of the season. The "ghoul of science, Mr. Reed" outdoes Stockton when he writes "that the animal now being brought to light weighed in life about sixty tons, that he had a neck thirty feet in length, and a tail perhaps sixty feet in length. His ribs are about nine feet in length, and the cavity of his body with the lungs and entrails out, would have made a hall thirty-four feet in length, sixteen feet in width, and arched over probably twelve feet in height. A round steak taken from the ham of the animal would have been at least twelve feet in diameter. * * * A set of fours in cavalry could easily have ridden abreast between his front and hind legs, provided he had not objected. Every time he put his foot down it covered more than a square yard of ground and must have fairly shaken the earth. * * * When we get it here we shall probably place it temporarily in the campus * * * and we shall work as rapidly as possible in restoring our great prize to a normal condition here at Larmie." This wonderful story is based on two little holes in the Freeze Out Hills, which required about a day to dig. When all is exhumed, if there is anything to exhume, it will be found that 'our great prize' is after all but a normal Dinosaur. The excitement produced by the story, however, has another side, and a good one, since it led our newest Museum to take up the making of a collection of extinct monsters.

One of the great needs for geological work in Wyoming is good maps. Those available this summer were very poor; therefore nothing was attempted in the way of preparing geological maps.

In addition to the collections made and the individual 'experience' the expedition secured a number of new species of invertebrates. They located two new leaf horizons in the Fox Hills formation, a limestone with an abundance of fossils in the Red Beds supposed to be of Triassic age, and an-

other abounding in fresh-water shells together with turtle and crocodile remains in the Jurassic Dinosaur beds. On the basis of the fossils collected this summer, the Carboniferous of Shirley Basin and the Grand Canyon of the North Platte are to be correlated with the Madison limestone of the Yellowstone Park. The Carboniferous at 'Specimen Hill,' near the ranch of John Burnett in the Little Medicine settlement, is, however, of Upper Carboniferous age.

Game at times was plentiful. On the plains, we saw daily from a few to as many as fifty antelope, but we rarely got nearer to them than a half mile. Sage hens were also abundant. In the mountains, two species of grouse were seen. Beaver dams we saw only in the region of Larmie Peak. Coyotes were noticed daily and nightly we never failed to hear their broken-voiced barking. Bears and mountain sheep were not seen, but occasionally we came across their tracks. Jack-rabbits were not common, eagles very scarce, and but four rattlesnakes were killed.

In conclusion, it is believed that the sentiment of the members of the Fossil Field's Expedition is voiced when it is stated that we were particularly fortunate in having Professor Knight as chief geologist, leader, and quartermaster. He did his work well, and we are the gainers in making his acquaintance.

"The Dinosaur, King of the mountains,
The largest of all vertebrates;
When he drank he exhausted the fountains,
And no one can tell what he ate.
He went about in the Jurassic,
And he'll never come back any more;
His bones lie here in Wyoming.
Three cheers for the old Dinosaur."

Vincent, Coe College.

CHARLES SCHUCHERT.

U. S. NATIONAL MUSEUM,
October 26, 1899.

SCIENTIFIC BOOKS.

THE 'THETA-PHI DIAGRAM.'

The Entropy-Temperature Analysis of Steam-Engine Efficiencies. By SIDNEY A. REEVE. New York. 1897. 8vo. Pp. 20, with folded diagram.

The Theta-Phi Diagram practically applied to Steam, Oil, Gas and Air-Engines. By HENRY A. GOLDING. London, Manchester and New York. 1898. 12mo. Pp. 127.

The Entropy-Diagram and its Applications. By J. BOULVIN. Translated by BRYAN DONKIN. London and New York. 1898. Pp. 70.

The 'temperature-entropy diagram,' the 'theta-phi diagram,' as some recent writers, following Macfarlane Gray, are coming to denominate it, was suggested, somewhat indefinitely and without illustration of its applications, by Belpaire, in 1872; by J. Willard Gibbs, in a very definite form and with clear statement of the uses to which such a diagram may be applied, in 1873–1878, and by later writers in increasing numbers and with as steadily increasing extent and usefulness of application, particularly in the treatment of the theory of the ideal heat-engines and in their comparison with the real engines of daily life. About 1889 Macfarlane Gray presented papers to the British Institutions of Naval Architects, of Civil and of Mechanical Engineers, in which he employed the diagram in 'the rationalization of Regnault's experiments on steam' and other work so skilfully and effectively that the attention of his profession was then called to the then novel device, with the result of its permanent introduction into the current methods of thermodynamics, pure and applied. It was subsequently used very extensively by Willans in the discussion of the efficiencies of his engines, as exhibited by a series of famous trials which were brought to an abrupt termination by the early death of that talented engineer; although supplemented with great ability by his coadjutor, Captain Sankey. Boulvin, Ewing, Donkin and Cerry have since introduced this method of discussion of efficiencies and wastes of the heat-engines into treatises on those machines and their theory, and it may be now safely assumed that the system of Gibbs and his contemporaries in its development has become fully established

as a correct and a fruitful method of discussion of thermodynamic problems and phenomena.

A number of books and papers in elaboration of this system have recently appeared, and of these we take up several for review together. The titles of papers in the list given in the footnote* are added as containing the earliest and most important applications of this method of study of the efficiencies of the heat-engines, and the latest addition to the algebraic discussion of the abstract theory of entropy-diagrams.

The little book issued by Professor Reeve contains one of the clearest and most complete explanations of the temperature-entropy diagram that we have met with. The purpose of the publication is the presentation of a new diagram in which the author has introduced some modifications of the form proposed by Boulvin and, as it is thought, thus made the work of preparation for entropy-temperature analyses much less troublesome than formerly; obviating the necessity of detailed computations for each analysis. With this diagram at hand, it is thought that "the entropy method, once understood, will be found to reveal with surprising speed and facility factors in steam-engine economy hitherto only to be estimated, at best, and that only at the expenditure of tedious labor." This paper was originally published in the interests of the engineers; but it cannot fail to have equal interest and value for those engaged in the study of mathematical physics and abstract thermodynamics. The diagram is well made, its explanation is admirably satisfactory, and the text is printed with equal excellence. The diagram consists of a sheet divided into four quadrants, of which one is devoted to quantities involving pressure-temperature determinations, the second to those related to entropy-temperature problems; the third gives entropy-volume quantities, and the fourth pressure-volume measurements. On these four sections of the sheet are laid down with care and accuracy the corresponding curves for water and steam, unity-weight in each case, and printed upon the sheet are also the heads for entries of all necessary data from observation at an engine trial, in the reduction of which this method is to be employed. The method of use of the system and of the diagram in its applications to heat-engines is very fully and lucidly described and illustrated.

The chart and its text will, unquestionably, be found to be very useful and helpful to every engineer seeking to enrich his work by the results of this system of exploration of the thermodynamic and the thermal and the dynamic phenomena of heat-engine performance.

Mr. Golding's 'Theta-Phi Diagram' and its illustrations of practical application of the Gibbs system of treatment of thermodynamic problems also find place in the work of the engineer employed in the investigation of the performance of engines, whether the working fluids be steam, gas, air or oil-vapor. The author employs geometrical rather than algebraic methods, where choice is allowed; illustrating the fact which will probably be observed by all familiar with the matter, that the designer and constructor, the mechanic in whom the art is inborn, is almost invariably a geometrician rather than an algebraist. The utility of the method presented is considered beyond doubt, and, as Mr. Robinson remarked in discussing a paper by Mr. Willans, whose disciple, Mr. Golding, evidently is, "Up to a certain point, the practical man might ignore the present paper and others like it; but if he aspires to design economical engines, he might derive more good from the study of, say, Mr. Macfarlane Gray's 'Theta-Phi Diagram' than from many portfolios of working drawings." In fact, the study of current practice, in working drawings, simply reveals the relative forms and proportions of well- and ill-designed engines and throws little light upon the causes and remedies of faults of construction or defects of practice. The author acknowledges indebtedness to the earlier writers, Boulvin,

* Belpaire, Th., 'Bulletin de l'Academie royale de Belgique,' 1872. Gibbs, J. Willard, 'Trans. Conn. Academy of Arts and Sciences,' 1873. Linde, C., 'The Refrigerating Machine of To day'; Trans. (Munich, 1875), A. S. M. E., 1893. Gray, Macfarlane, 'Trans. Inst. Naval Archts.,' 1889; Inst. C. E., 1889; Inst. Mech. Eng'rs., 1889. Willans, P. W., 'Steam-Engine Trials'; Minutes Proc. Inst. C. E., 1888–1893. Sankey, H. R., Proc. Inst. M. E., 1891; Proc. Inst. C. E., 1895–6. Durand, W. F., Jour. Am. Soc. Naval Engineers, May, 1898, Sibley Journal, 1898.

Gray, Willans and others; but he is himself certainly entitled to the thanks of the scientific and the practical worker in the field of thermodynamics, pure and applied, for the extent to which he has developed his theme, and for the excellence of his own work. The information given by Mr. Golding had hitherto been scattered through various technical periodicals and transactions of learned societies, often quite inaccessible to the average practitioner, and its collection into a formal and logical treatise is a veritable boon to the student of heat-engine-efficiencies, whether as scholar, simply, or as practitioner of the art of engine-design and construction. The text is clear and well-written, and the profuse illustration and excellent engraving throughout the book are worthy of all praise. The tables, so far as we have checked them by differences, seem accurate and the diagrams are remarkably well-selected as illustrations of the facts and principles involved in the discussion. Boulvin's diagram is introduced as the 'complete entropy-diagram' and its use is well-explained and illustrated.

The entropy of water and of steam are computed and tabulated; the standard engine-cycles and their details are discussed; the effects of jacketing and compounding the steam-engine and those of superheating and of initial condensation are studied; the conversion of indicator to entropy-diagrams is shown and the thermodynamics and physics of the steam-engines are treated at ample length. Similarly complete discussions of the air, gas and oil-engines are presented and many novel applications of the system are shown. The book, as a whole, is an admirable presentation of its subject. A valuable feature is a new table of the weights of saturated steam per cubic foot, for each one-tenth-pound pressure, up to 219, with differences computed for each one one-hundreth or a pound per square-inch.

Professor Boulvin's work, as translated by Donkin, is that of a master in the new art. Its author was one of the first to appreciate and to take up the Gibbs' system of thermodynamic discussion and incorporated it into his work on the steam-engine, published in 1893. The present work appeared in the *Revue de Mécanique* in 1897, and, at the request of Mr. Donkin, who offered to make the translation into English, the author consented to reproduce the discussion in book form. It is, as the translator says: "A short syllabus of the principles of thermodynamics as applied to heat-engines and its chief claim to originality lies in its systematic method of using temperature-entropy diagrams." The author deduces a 'heat-balance' from the data of a steam-engine trial, by the employment of the theta-phi chart in a very simple and direct manner, and avoids the lengthy and troublesome computations necessary in the algebraic system of Hirn. The older systems were incomplete; the present is practically perfect in many points in which the others were defective. The 'complete entropy-chart' of Boulvin is especially useful in this work. The Boulvin diagrams and chart afford a means of not only making a heat-balance, but also of following the movements of heat throughout the cycle, and this without other computations than those required in reducing to scale the quantities to be dealt with. As observed by the translator: "The best standard of efficiency for the steam-engine has been much discussed and the question would be practically solved if, for every steam-engine, we had entropy-diagrams, all traced to the same scales of entropy and temperature for a unit-weight of steam coming from the boiler. These diagrams could be compared with each other, and in any country, and the smallest variations in the work of each engine graphically shown without any explanation being necessary." In this publication, Professor Boulvin has added a new method of dealing with clearances and throttled steam; ascertaining the action of the walls of the cylinder in heat-exchanges, and representing it in all cases independently of the extent or character of compression. The weights and measures employed are in this work entirely metric and the student can thus find in the last-named two treatises opportunity to compare the same methods, employing these different symbolic and measuring systems for similar purposes.

The plan of the book is thoroughly systematic, commencing with a study of the funda-

mental laws of thermodynamics, giving the relations between temperature and entropy, the study of cycles, entropy computations, applications to vapor and gas-engines, and closing with elaborate illustration in discussion of the results of a steam-engine trial. The discussion of the physics of steam by this method is particularly complete and valuable and the tables appended will be found useful on many occasions. Within the sixty-six pages of text there are to be found abundance of suggestions and instruction and the whole is written in a thoroughly scientific and systematic manner, without waste of words or loss of energy in diffuse explanation.

It should be noted by the readers of these little treatises that, occasionally, in the diagrams, an error will be noted in the assignment of a quantity of entropy to a mixture of steam and water less than that of water alone.

The interested reader of this collection of brochures should complete his work, if not already familiar with them, by examining the added list of papers. Professor Gibbs, as the real pioneer in the use of this interesting method, Linde as the first to apply it to the refrigerating machine, Gray as the writer whose enthusiastic and painstaking elaboration of the system first brought it to the attention of engineers in such a manner as to insure its careful examination and later general use, Willans, the pioneer in its application as a regular process of reduction of observational data to form for deduction, and Sankey, his co-laborer, also, are entitled to distinction only less than that accorded to the founders of the science which this system illustrates. Professor Durand, illustrating talent as an instructor as well as familiarity with the state of the art to date, presents the most complete and intelligible exposition of the theory of the entropies—for he shows that there may be an indefinite number—and, availing himself of suggestions by Ancona in a very notable paper in the *Zeitschrift* of the German Society of Civil Engineers for 1897, produces diagrams which are read with great ease and interpreted as readily. This is a luminous and clear as well as concise exposition of the subject.

R. H. THURSTON.

Alternating Currents of Electricity and the Theory of Transformers. By ALFRED STILL. Whittaker & Co. 8vo. 1898. 179 pages.

Alternate Currents in Practice. Translated from the French of Loppé and Bouquet by F. J. MOFFETT. Whittaker & Co. 8vo. 1898. 372 pages.

In the application of science to engineering the scientific principles involved have usually been very fully developed beforehand by the student of pure science. In the engineering applications of alternating currents, however, our educational and scientific men have been behindhand. The fundamental mathematical principles of alternating currents have indeed been developed mainly by men outside of the engineering profession, as exemplified by the epoch-making book of Bedell and Crehore, but the theory of actual engineering apparatus, such as the transformer, the rotary converter, the induction motor, etc., has been developed mainly by the engineer, and during the past few years our electrical engineering instructors have been looking eagerly to the manufacturing electrical engineer, not only for the details of design and construction, but also for the full and complete theory of their machinery as well. The engineer who has contributed most in this line is perhaps C. P. Steinmetz.

The electrical engineering instructor has now access to literature containing very complete developments of fundamental principles and very complete theoretical analysis of actual engineering machinery, and the problem which confronts him is to adapt this wealth to the requirements of instruction.

Instruction in electrical engineering should consist of two parts, as it seems to us, namely, an elementary part in which the general principles of the various branches of the subject are systematically developed, and a more practical part devoted to the design, construction and operation of machines, appliances and installations. In some branches of electrical engineering, indeed, the elementary part is little more than a course in theoretical electricity, but in alternating currents a great variety of principles arise which are not properly included in any general course in electrical theory, and it seems proper for the student to

be taken through a course of study in the analytical theory of the alternator, the transformer, etc., before beginning the practical study of alternating current appliances.

The separation of theoretical and practical treatises seems to us to be highly desirable, for our experience is that nothing obscures an elementary treatise (that is, the elementary part) so much as the introduction of practical matter not needed for purposes of illustration, and we conceive that nothing is so annoying to a well instructed engineer as to have his engineering literature highly diluted with elementary matter.

Alternating Currents, by Alfred Still, is an excellent, clean cut, elementary treatise. Pages 1 to 116 are devoted to the general principles of alternating currents and the remainder is devoted to the theory of the transformer. In reading this book one has a desire to know what the author might have to say of the synchronous motor and rotary converter, and of the induction motor, so simply and satisfactorily is the theory of the transformer worked out. One cannot of course judge whether or not the author realizes the paramount importance of these machines and the need for a simple exposition of their theory.

In speaking of the expression $B = \mu H$ the author says that "the point which is not generally clearly explained is that there is no necessity whatever, to consider the iron core removed, or even to imagine longitudinal holes drilled through the mass of the iron in order to understand what is meant by H in the above relation." However, we do not know what actually takes place *in* magnetized iron and in the specification of the state of magnetization of a rod we can, and do, specify only what is happening outside the rod or in holes drilled through the rod.

In speaking of magnetic leakage the author devotes his attention mainly to that case in which the *trend* of the useful magnetic flux would be but little altered by the removal of all iron parts the flux being, of course, reduced in value. In this case the magnetic leakage generally decreases with increasing excitation. The most frequent case in practice, however, is that in which the *trend* of the useful flux would be greatly altered by the removal of the iron parts, as for example in the dynamo. In this case the magnetic leakage increases with increasing excitation.

Mr. Still's book "has been written not only for engineering students, but also for those engineers who are but slightly acquainted with alternating current problems." We cannot agree with the author that for this class of readers analytical methods are unsuitable for the solution of alternating current problems. The engineer who attempts the graphical method soon finds it to be impracticable except only as an aid in the formulation of analytical solutions. Steinmetz' method seems to us to be the simplest method for obtaining numerical results and the only method to be called practicable.

Alternate currents in practice, translated from the French by Francis J. Moffett, is a good discussion of a great variety of practical alternating current apparatus with comparatively little useless or misplaced elementary matter. Mr. Moffett says that to the best of his knowledge there is no work in existence in England at the present time which treats in a practical manner the whole range of alternating currents of electricity and we do not know of any such work in America for the admirable works of Bedell, Jackson and Steinmetz are distinctly theoretical.

W. S. Franklin.

Das Tierreich Sporozoa. By Alphonse Labbé. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Herausgegeben von der Deutschen Zoologischen Gesellschaft. 5 Lieferung. Protozoa, Sporozoa. Berlin, Friedländer & Sohn. 1899. Pp. xx + 180.

As indicated by the descriptive title of Das Tierreich, a zoological dictionary of which Franz Eilhard Schultze is the chief editor, it is no part of the undertaking to give a general account of the classes of animals considered, but merely recognizable descriptions of all known species. For the present volume—the Sporozoa—a better man than Alph. Labbé could not have been chosen, and, so far as the sporulation is concerned and the determination of species through spores, or the hosts of the

parasites, the location within the hosts, or the bibliography of each species, the book is eminently successful. Apart from the Gregarinida where the descriptions are more complete, a criticism might be justly made against the extreme brevity of the specific descriptions, especially where they deal with the adult organisms. For example, an adult form of the genus *Coccidium*, the sporulation of which is given for 17 species besides numerous varieties, is nowhere described. Of course the sporulation is the more important and the omissions are more than offset by the splendid bibliography which accompanies each specific name. One hundred and ninety-six figures, for the most part of spore-stages, accompany the descriptions.

In accordance with the rules of nomenclature adopted by the Deutchen Zoologischen Gesellschaft, the names of legions end in IDIA, the names of orders in IDA, of sub-orders, in INA, of tribes, in EA, of families in IDAE, and of subfamilies in INAE. It is a relief to feel that, in the future, there will be no excuse for such haphazard terminations and names as have characterized the Sporozoa groups heretofore.

The classification adopted by Labbé is based, in its main divisions (legions and orders) upon his classification of 1894. The two legions are the *Cytosporidia* and the *Myxosporidia* (his *Histosporidia* of 1894), the former containing four orders: *Gregarinida*, *Coccidiida*, *Hæmosporidiida*, and *Gymnosporidiida;* the latter, two; *Phænocystida* and *Microsporidiida*. *Sarcosporidia*, *Amœbosporidia* and *Serumsporidia* are placed as Sporozoa *incertæ sedis*, the terminations indicating legion-value. Delage and Hérouard's suborders of the Gregarinida are adopted (*Cephalina* and *Acephalina*), while the tribes and families are adapted from Léger. He follows his own classification of the *Coccidiida*, dividing them into two sub-orders: *Polyplastina* and *Oligoplastina*, the former into two tribes: *P. digenetica* and *P. monogenetica;* the latter into three tribes: *Tetrasporea*, *Trisporea* and *Disporea*, while family-groupings are discarded. It is to be noted that the single form in the tribe *Trisporea* is his very questionable genus *Bananella*, which Léger and others regard as an anomalous type of a four-spored (*Tetrasporea*) form, and which Labbé himself admits may sometimes ('*accidentellement*') have four spores. The *Hæmosporidiida*, without further sub-divisions, contains the three genera *Lankesterella* (Labbé), *Caryolysus* (Labbé) and *Hæmogregarina* (Danilewsky). The *Gymnosporidiida*, without further sub-divisions, contains six genera: *Caryophagus* (Steinhaus), *Halteridium* (Labbé), *Hæmoproteus* (Kruse) *Plasmodium* (Marchiafava & Celli), *Laverania* (Grassi & Feletti *em.* Labbé), and *Cytamœba* (Labbé). For the terminology of the Malaria-organism (*Plasmodium*) which was first recognized by Laveran in 1880 and, in 1883, named by him *Oscillaria malariæ*, Labbé takes the generic name applied to it in 1885 by Marchiafava & Celli, and Laveran's specific name, thus giving the Malaria organism the somewhat unfamiliar name of *Plasmodium malariæ*. On the ground of priority this name must supplant the, in some respects better, term *Hæmamœba*, given by Grassi & Feletti in 1890, with the advantage, however, of a more descriptive specific name in *malariæ*, than has hitherto been known in Labbé *laverani*. On the whole, therefore, the new name *Plasmodium malariæ* is fully as good as the one it supersedes—*Hæmamœba laverani*. Labbé now makes two certain sub-species: *P. malariæ tertianum* (Golgi) and *P. mal. quartanum* (Golgi), and two questionable sub-species: *P. mal. præcox* (Grassi & Feletti) and *P. mal. immaculatum* (Grassi & Feletti).

Of the four families of the *Myxosporidia*, three belong to the order *Phænocystida* (*Myxinidæ*, *Chloromyxidæ*, *Myxobolidæ*) and one to the order *Microsporidiida* (*Nosematidæ*).

The volume contains a well-arranged list of the hosts of Sporozoa with the organs affected, while a key to families and genera, and in most cases to the species, will materially assist the student in placing forms.

Taken, as a whole, the volume is a very welcome addition to the literature of the Protozoa.

GARY N. CALKINS.

COLUMBIA UNIVERSITY,
NEW YORK CITY, October 30, 1899.

Leitfaden für das zoologische Praktikum von DR. WILLY KÜKENTHAL, Professor in Jena. Mit 172 Abbildungen im Text. Jena, Verlag von Gustav Fischer. 1898.

This guide consists of an 'Introduction' of four pages on instruments and general directions followed by eleven pages on the 'Elements of Histology' and 269 pages on the various groups and types of animals.

The list of animals named for special study represents 76 genera and 83 species—a list that indicates the author tried to live up to the statement in the preface that the zoological laboratory of to-day does not simply offer a few local types for dissection, but rather constitutes a practical 'Repetitorium' of the fundamental facts of zoology.

The work is divided into 20 'courses' distributed among the nine phyla recognized as follows: Protozoa (pages 15), Platodes (7), Echinodermata (21) and Tunicata (14), each one course; Vermes (Bryozoa, Chætognatha, Annelida) (28), Mollusca (37) and Arthropoda (29), each two courses; Cœlenterata (43) four courses and Vertebrata (76) five courses. The first course is devoted to Elements of Histology.

Each course or group of courses is preceded by a 'Systematischer Ueberblick' of the phylum in which the classification is carried out to the orders and suborders. In this systematic epitome each category is more or less briefly characterized and one or two representatives are noted under each order or suborder. This is followed by a bit of technique, this by a general survey and this by the 'special course.' The treatment of the Coelenterata may serve as illustration of the plan. In this group the order is as follows: (1) 'Systematischer Ueberblick' of courses 3–6, (2) 3 Kursus (pp. 34–43). (3) Porifera. 'Technische Vorbereitungen.' (4) A. Allgemeine Uebersicht. (5) B. Specieller Kursus. (6) 4 Kursus (pp. 43–55). Hydroidpolypen. Technische Vorb., etc., as (4) and (5). (7) 5 Kursus (pp. 55–65). Tech., etc. (8), 6 Kursus (pp. 66–73). Anthozoa, Tech., etc. The general account of the phylum is brief and the 'special course' is a running account of the anatomy of the laboratory specimen with directions for dissection introduced whenever deemed necessary.

The reviewers experience is not favorable to the introduction of systematic and general surveys into a laboratory guide, and why a general account of a phylum should be preceded by a special technique is not clear to him. There are sound pedagogical reasons for logical order and for keeping a laboratory guide to its business.

As a laboratory guide for a beginner the book is not detailed enough and can hardly stand with such guides as those of Marshall and Hurst, Parker and others in English.

The illustrations, of which there are 172, are as a rule good. Quite a number of them, about 75, are original. Some of these could be improved. Figure 152, for example, would hardly assist a beginner in his search for the uterus or the bladder of the frog. It would also be uncertain work for a beginner to identify the ovary of a young frog either by the figures or the descriptions. On the whole, however, the original figures are good and welcome. The typographical work is of course neat, clean and agreeable—for it comes from the establishment of Gustav Fischer.

HENRY F. NACHTRIEB.

BOOKS RECEIVED.

Leçons de chemie physique, professées à l'université de Berlin. J. H. VAN'T HOFF. Translated from the German by M. CORVISY. Second Part, *La statique Chemique.* Paris, Hermann. 1899. Pp. 162.

Leçon nouvelles sur les applications géométriques du calcul différentiel. W. DE TANNENBERG. Paris, Hermann. 1899. Pp. 192.

Recherches expérimentales sur les oscilations electriques. A. TURPAIN. Paris, Hermann. 1899. Pp. 152.

Biological Lectures from the Marine Biological Laboratory, Wood's Holl, Mass. Boston, Ginn & Co. 1899. Pp. 343.

Animal and Plant Lore. FANNY D. BERGEN. Boston and New York, published for the American Folk-Lore Society by Houghton, Mifflin & Co. 1899. Pp. 180.

Evolution by Atrophy. J. DEMOOR, J. MASSART and E. VANDERVELDE, translated by Mrs. CHALMERS MITCHELL. New York, D. Appleton & Co. 1899. Pp. xiii+322.

SCIENTIFIC JOURNALS AND ARTICLES.

THE principal article in the *National Geographic Magazine* for November is on 'The Alaskan Boundary,' originally given as a lecture before the National Geographical Society by Hon. John W. Foster, ex-Secretary of State, and at present a member of the Joint High

Commission. The paper presents the most complete summary of the Alaskan boundary dispute thus far made. Mr. Foster states that the dispute really dates from 1898, when it was presented without previous warning before the Joint High Commission which had assembled in Quebec. A number of maps which are offered as testimony show that on all the principal English maps the boundary line is as given on the American maps. Professor Alfred P. Dennis concludes his description of 'Life on a Yukon Trail,' begun in the October number. An article by Professor W. M. Davis, of Harvard University, on 'The Rational Element in Geography,' is the first of a series on methods of teaching and studying geography. There has been a steadily growing demand in the last few years for the better teaching of geography, and as earnest an effort on the part of many teachers to meet that demand. The *National Geographic Magazine* proposes to aid the work by presenting in its pages a series of articles by those most fitted to speak—able geographers who are also teachers of renown. The article by Professor Davis will be followed by a second from him on field and laboratory methods of teaching geography. Commissioner Harris, of the Bureau of Education, will treat the subject in several of its aspects, and a number of other equally prominent educators have promised articles which are to appear in the magazine within the next few months.

THE Chicago University Press has added to its publications the *Manual Training Magazine*, the first number of which was issued on October 1st. It is edited by Mr. Charles A. Bennett, of the Bradley Polytechnic Institute, Peoria.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES.

SECTION OF ASTRONOMY AND PHYSICS.

THE first meeting since the spring of the Section was held on 2d October, 1899, at 12 West 31st Street. Professor William Hallock read a paper on 'Compound Harmonic Vibrations of a String.' He said that some German experimenters have determined experimentally by photography the motions of different points of a vibrating string. The vibration varies, of course, according to the part of the string bowed, the speed, the kind of bow, etc. His paper, however, consisted essentially of a set of curves, calculated from the theoretical formulæ, showing the successive positions of a string vibrating under the influence of a fundamental and the first seven overtones. Each curve shows the position of the string at a particular instant. Sixteen such curves are shown for the first sixteen sixty-fourths of a complete period of the fundamental. The amplitude of the component is proportional to the wave-lengths, in each case. Thirty-two points were computed for each curve. Each curve is computed from the formula

$$y_1 = a \sin 2\pi \frac{t_1}{T_1} \sin 2\pi \frac{x_1}{l_1}$$
$$+ b \sin 2\pi \frac{t_1}{T_2} \sin 2\pi \frac{x_1}{l_2} + \text{etc.} \cdots$$
$$+ h \sin 2\pi \frac{t_1}{T_8} \sin 2\pi \frac{x_1}{l_8},$$
$$a = 2b = 3c = 4d = 5e = 6f = 7g = 8h,$$
$$T_1 = 2T_2 = 3T_3 = 4T_4 = 5T_5 = 6T_6 = 7T_7 = 8T_8.$$

In the discussion Professor Pupin said that it would be interesting to photograph the vibration of a string loaded, and also unloaded. Such a study might help our theories of electrical waves along a cable.

WM. S. DAY,
Secretary.

SECTION OF GEOLOGY AND MINERALOGY.

AT the meeting of October 16th, after Mr. Geo. F. Kunz, the Chairman, had exhibited certain specimens, the regular paper of the evening was presented by Professor J. J. Stevenson on 'The Section at Schoharie, N. Y.' The Schoharie Valley is an indentation in the Helderberg Mountains, about 35 miles southwest from Albany, N. Y. It is of interest as showing a section from the Hudson to the Hamilton, with almost continuous exposures at various localities. This was examined during last summer with the view of making comparisons with conditions observed in parts of the Appalachian region within Pennsylvania and Virginia. There are some notable contrasts between the northern and the southern sections. At Schoharie, the Medina is wanting

and the greenish shales of Clinton rest on the Hudson. In southern Pennsylvania and in Virginia, the red and white Medina are both present and Hudson forms pass upward into the red Medina, occurring abundantly in southwest Virginia in a bed only 100 feet below the white Medina. At Schoharie, the Niagara is differentiated physically from the overlying Waterlime, but much of the Niagara fauna passes into the Waterlime; in localities further west and south, the Salina shales intervene and there is no passage of fauna. The upper Waterlime at Schoharie differs greatly in color and composition from the Tentaculite or lower divisions of the Helderberg, but at least two forms, most characteristic of the Tentaculite, are found in the upper Waterlime. These forms were not observed by the writer in the Waterlime of southern Pennsylvania. The several sub-divisions of the Helderberg are very distinct physically, the boundaries of each being sharply defined; but the physical changes were such as to cause only gradual disappearance of the several faunas and forms, which persist throughout, showing little variation. The passage from Helderberg to Oriskany, at Schoharie, is abrupt to the last degree—from a very good limestone to a ferruginous and only slightly calcareous sandstone. The faunal change is as abrupt as the physical. Here again the contrast is very great, for, in southern Pennsylvania, the passage from Helderberg to Oriskany is very gradual through a silicious limestone, containing forms belonging to each. In southwest Virginia the upper part of the Helderberg becomes silicious and in some localities is almost a sandstone.

In response to a request from the Chairman for notes on geological observations during the last summer, Professor Kemp reported on the progress of his geological survey of the Adirondack region. One result was the recognition of a true quartzite of pre-Cambrian date, affording thus a fragmental sediment. The sedimentary rocks in the region he found to be widely charged with graphite, indicating an abundance of organic life in pre-Cambrian time. Further types of eruptive rocks had also been identified, to fill up gaps in known series.

Professor Osborn related some results of a visit, with Dr. Matthews, to the Como Bluffs Section, south of the Union Pacific Railroad, three hours west of Laramie; the more certain establishment of its Jurassic character, with bed containing remains of Dinosaurus about 40 feet below the top (a fresh water deposit), while, in the marine beds below, belemnites and btanodon were found, the latter serving as nuclei for concretions. Professor Osborn also described the mode of occurrence of the mastodon recently found by a German, while digging in his market garden, three miles back of Newburgh, N. Y.

Professor R. E. Dodge gave a preliminary account of his work on the Pueblo ruins at Pueblo Bamlo, New Mexico. The deposits on which the ruins are situated seem to indicate a a very long occupation of the country previous to the desertion of the ruins.

Dr. A. A. Julien discussed the common distribution of opal or hyalite; and the exclusively recent character of all existing occurrences of this mineral.

Mr. Geo. F. Kunz described his recent visit to the ancient locality of jade (nephrite) at Jordaensmühl, near Breslau, Germany, with the special object of study of the minerals associated with jade. In an ancient quarry for road material, immense masses of zoisite-quartzite occurred, forming columns thirty feet in height.

Dr. Hovey presented some notes of an excursion with Professor Iddings to the Yellowstone Park.

ALEXIS A. JULIEN,
Secretary of Section.

THE CHEMICAL SOCIETY OF WASHINGTON.

THE regular meeting was held October 12, 1899.

The first paper was read by Mr. J. K. Haywood and was entitled, 'The Determination of Glycogen,' by J. K. Haywood and W. D. Bigelow.

The authors proved that methods for the estimation of glycogen, which depend on its direct inversion into dextrose, are unreliable and have modified the method of Brücke so as to make it accurate and fairly rapid.

The second paper was read by Dr. F. K. Cameron and was entitled, 'A Method for Estimating Black Alkali in Soils.'

The method enables the determination of the degree of hydrolization of the sodium carbonate in soils and soil crusts containing this compound. It was shown that an accurate determination of the amount of sodium carbonate could not be made by titrating directly with a standard acid, two reactions taking place with the formation of the acid carbonate in varying quantities and furthermore the probable existence of acid carbonate in the soil adds to the difficulty of such a determination. It was shown that acid potassium sulfate is free from these objections, the reaction taking place with quantitative exactness according to this equation :

$$Na_2CO_3 + HKSO_4 = NaHCO_3 + NaKSO_4$$

both substances indicated in the right member of the equation being neutral. It should be borne in mind that acid sodium carbonate although a neutral substance towards indicators, quite rapidly and readily inverts with the formation of the alkaline normal carbonate, so that a reasonable degree of speed must be used in making the titration.

Details of the practical application of the method with examples from practice, were given, and it was shown that in ordinary practice the method was easily capable of an accuracy indicated by a probable error of less than 0.02 of 1 per cent.

The last paper was read by Dr. H. W. Wiley, and was entitled, 'The Fifteenth Annual Meeting of the Association of Official Agricultural Chemists, at San Francisco, July 5–7, 1899.'

Mr. Tassin exhibited a specimen of calcium chlorid which he had obtained from a muck soil found in Utah. The soil occurs as an incrustation between Salt Lake City and Salt Lake.

Dr. Bolton exhibited a bibliography of thallium compiled by Miss Martha Dunn and recently published by the Smithsonian Institution. He called attention to the work done in Paris by Jules Garcon, who has published a bibliography of the 'Chemical Technology of Textile Fibers,' and a pamphlet entitled, 'Resources of Bibliography of Chemistry.' The latter consists of a list of chemical bibliographies.

WILLIAM H. KRUG,
Secretary.

ONONDAGA ACADEMY OF SCIENCE.

THE September meeting was devoted to ornithology. Mr. J. A. Dakin spoke on the subject from an economical standpoint, and expressed the belief that the slaughter of birds for ornamentation is a chief factor in the destruction of farm crops by insects. Dr. W. M. Beauchamp considered forest denudation and changed food habits a more important factor.

Principal J. D. Wilson spoke on the study of birds from a naturalist's rather than a collector's standpoint, citing instances of familiarity between birds and their human friends and also his own experiences in taming young wild birds and studying their habits.

Mr. A. Perrior read a paper on 'The Oneida Lake Heronry.' In the tall trees of a submerged swamp at the north of Oneida Lake about five hundred pairs of Great Blue Herons (*Ardea herodias*) congregate annually at the breeding season. The nests are two or three feet in diameter and composed of half-inch sticks lined with finer twigs. Frequently two or three, and occasionally four, nests are built in the same tree, and are used indefinitely, being repaired from year to year. Mr. Perrior exhibited specimens of birds and eggs and also photographs taken among the tree tops.

At the October meeting Professor Hargitt spoke on the recent appearance in the county of the periodic *Cicada septendecim*, Riley's Brood No. XIX. The visitation lasted only about a month, was confined to parts of the towns of Onondaga and Dewitt and less damage was done than anticipated. The English sparrows were observed to feed greedily on the Cicadas, migrating in large numbers to the woods southeast of Syracuse. The brood is probably growing smaller in this county. Dr. Beauchamp confirmed the rumors of the Onondaga Indians feasting on the Cicadas and called attention to the restricted area of visitation, the Cicadas being confined to the central towns of the county.

Mr. H. W. Britcher spoke briefly on 'Protective Habits and Resemblances of Onondaga County Spiders,' and exhibited a number of live specimens illustrating the cases cited.

H. W. BRITCHER,
Corresponding Secretary.

DISCUSSION AND CORRESPONDENCE.

COLOR ASSOCIATIONS WITH NUMERALS, ETC.

To the Editor of Science: In Science, Vol. VI. (1885), p. 242, I printed a note of experiments on color-associations with letters of the alphabet, days of the week, etc., in the case of my daughter Mildred. The subject was again treated, at more length, in *Nature* for July 9, 1891, p. 223. On p. 224 a table was given showing the color-associations for my daughter in 1882, 1883, 1885, 1887, 1889, 1891. Since that time I have tested her color-associations on two occasions. In February, 1895, her replies agreed exactly with the last column of the table cited except that the color for 8 was marked as 'white.' An experiment in August, 1899, agrees precisely with the results of 1895. I think the present note has a value because the experiments it describes now cover a period of seventeen years and give a history, not an isolated record.

Edward S. Holden.

THE WAGNER FREE INSTITUTE OF SCIENCE AND PROFESSOR DALL.

On Monday, October 30th, the Wagner Free Institute of Science in Philadelphia presented to Professor William Healey Dall, of the Smithsonian Institution, a gold medal as a slight token of their appreciation of his work in connection with the Transactions of the Institute. The medal has the head of the founder of the Institute on the obverse side, with the name of the Institution. On the reverse is engraved "Awarded to William Healey Dall for his investigations and writings in Paleontology—1899."

Accompanying the medal was a very handsomely engrossed book of resolutions stating that "Whereas, Professor William Healey Dall has contributed greatly to the advancement of Science by his investigations in the department of tertiary geology and has rendered most valuable service to the Wagner Free Institute of Science by enabling it, through his numerous and exhaustive contributions to its Transactions, to publish the results of his investigations to the world. Now, therefore, be it Resolved by the Board of Trustees and the Faculty of the Wagner Free Institute of Science that a medal be prepared and presented to Professor Dall in recognition of his distinguished services in the cause of Science and in testimony of the high appreciation of his work by the Trustees of this Institute."

The work on the Tertiary Fauna of Florida, begun in 1886 under the auspices of the Wagner Free Institute of Science, constitutes one of the most important advances in American Paleontology. The discovery of the Pliocene beds of the Caloosahatchie river by Professor Heilprin and Mr. Joseph Willcox in 1886 and the subsequent investigations by Dr. Wm. H. Dall have completely revolutionized the geological theory as to the formation of the Peninsula of Florida and the adjacent States.

The Transactions of the Institute have not only met with the highest commendation from American Paleontologists and Conchologists but from the European scientists as well. On several occasions prominent men from various parts of Europe have visited the Institute to see, as they said: "The Institution that has published such valuable and finely executed Transactions."

Some idea of the amount of labor involved in Dr. Dall's work may be gained from the following summary:

The total number of pages in the four parts of Vol. III. is 947, with 35 plates that contain 639 figures, and one map.

Part I. On the Gastropods. Contains references to over 300 species including the descriptions of 122 new species and varieties, that are represented on twelve plates by 192 figures.

Part II. Is a continuation of the Gastropods, as introductory chapter on the Marine Pliocene Bed of the Carolinas, and is followed by references to upwards of 400 species including the descriptions of 156 new species and varieties that are illustrated by 203 figures.

Part III. Forms an introductory chapter to Part IV. containing a new classification of the Pelecypoda, with an enumeration of the differential characters of the orders, suborders, superfamilies and families, a statement of their range in geological time, and an enumeration under each family of the chief generic groups believed to be referable to it.

In Part IV. Dr. Dall has greatly enlarged on the subject, giving a complete synopsis of many of the leading generic groups of American Tertiary species. Upwards of 500 species and varieties are enumerated, including 152 new to science. These are shown on 13 plates containing 244 figures.

The Pliocene fauna is closely allied to the recent, and Dr. Dall in his investigation has been obliged to make so many changes in nomenclature, that the work is indispensable to the paleontologist and conchologist.

In 1893 Professor Dall edited the republication of Conrad's 'Fossils of the Medial Tertiary of the United States' a work of 136 pages and 49 beautifully executed plates. In 1898 he wrote for the Transactions (Vol. 5), Notes on the Paleontological Publications of Professor William Wagner. Several plates prepared by Professor Wagner in 1839, but never published with text, were found in the Institute library. The plates were new species of fossils from the Carolinas for which credit was given in Brown's Index Paleontologicus, but there was no record of the original paper.

Professor Wagner doubtless had the plates prepared for the Journal of the Academy of Natural Sciences, and afterwards contented himself with sending the plates to his correspondents. THOMAS L. MONTGOMERY.

PHILADELPHIA, Nov. 10, 1899.

THE CARNEGIE INSTITUTE.

THE fourth annual celebration of Founder's Day, of the Carnegie Institute at Pittsburg, was held on November 2d. President Arthur T. Hadley, who was the guest of honor, presented an address upon 'Modern Changes in Educational Ideals.'

Mr. Samuel H. Church, the secretary of the Board of Trustees, read the annual report of the progress of the year in all departments of the Institute, stating that a considerable plot of land had been secured to the east of the buildings for additions already planned, which are to provide space for a permanent picture gallery, an art school, and for the scientific museum.

The department of paleontology, recently established under the curatorship of Dr. Wortman, has progressed rapidly. The expedition to Wyoming this summer has resulted in the securing of a large collection of unusually fine fossil bones of extinct vertebrates.

Several addresses upon art were given, and the announcement was made of the prizes awarded for paintings entered in the Carnegie Institute exhibit for 1899.

Dr. J. L. Wortman then reported on the work of the museum in paleontology.

HARLAN I. SMITH.

ALCOHOL AS FOOD.*

BULLETIN No. 69 of the Office of Experiment Stations of the U. S. Department of Agriculture gives the first detailed accounts of a number of experiments lately made by the Department in coöperation with Wesleyan University and the Storrs Experiment Station, under the immediate direction of Professor W. O. Atwater. These experiments were made with men in the Atwater-Rosa respiration calorimeter described in Bulletin No. 63 of the Office Experiment Stations. The object of the inquiries is the study of the laws of nutrition. Each experiment lasts from four to twelve days, during which time the man under experiment lives day and night in the chamber of the calorimeter. He has different kinds and amounts of food, and is under different conditions of activity, from actual rest to severe muscular or mental work. The results show how the body uses its food, what materials are needed for its support, and how different food materials compare in nutritive value. The six experiments reported in Bulletin No. 69 were made with a variety of dietaries and in two of them alcohol made a part of the diet.

The general plan of the experiments consists first in finding a diet of ordinary food materials, such as meat, potatoes, bread, and coffee, which is sufficient to meet the demands of the man's body when he is at rest, and in determining just how much of the different materials must be added to meet the increased demands when the man is engaged in more or less severe muscular work. Arrangements are made by which all the food and drink supplied to the body, and

* From the Division of Publications, United States Department of Agriculture.

likewise all the excretory products given off from the body, are measured and analyzed. Even the air before and after it is breathed is thus treated. This gives the exact income and the outgo of matter of the body. Furthermore, the energy which is latent in the material supplied to the body, and in the excretory products given off from the body, is carefully determined; while the energy that is transformed by the body and given off in the form of heat and external muscular work is very accurately measured by the calorimeter. We thus have an exact measure of the income and outgo of energy. By thus striking the balance of income and outgo of both matter and energy, it is possible to learn with great accuracy just how the body utilizes the different materials supplied to it in food and drink.

When results had shown what quantities of food ingredients were required for the maintenance of the man's body when he was at rest, and how much more was necessary to enable him to perform a measured amount of muscular work, the experiments were repeated, but with this variation: A certain amount of the fuel ingredients of the food—sugar, starch and fat —which the body uses to furnish heat for warmth and energy for work, was taken out, and a chemically equivalent amount of alcohol was substituted for them; that is, an amount of alcohol which contained the same quantity of potential energy as the ingredients which it was to replace. As a matter of fact, the amount actually used was 2½ ounces of absolute alcohol per day—about as much as would be contained in three average glasses of whisky, or in a bottle of claret or Rhine wine. This alcohol was given in six nearly equal parts, three with meals and three between meals, the object being to avoid any especial influence of the alcohol upon the nerves, and thus to test its action as food under normal bodily conditions. In the experiments in which the man did no muscular work, this amount of alcohol furnished about one-fifth of the total energy of the food; but in those with hard muscular work more food was given, so that the alcohol supplied only about one-seventh of the energy.

As regards the special action of alcohol three important results were observed in these experiments: (1) Extremely little of the alcohol was given off from the body unconsumed, in the breath or otherwise. The alcohol was oxidized, *i. e.*, burned, as completely as bread, meat, and other ordinary foods, in the body and in the same way. (2) In the oxidation all of the potential energy of the alcohol burned was transformed into heat or muscular energy. In other words, the body transformed the energy of the alcohol just as it did that of sugar, starch and fat. (3) The alcohol protected the material of the body from consumption just as effectively as the corresponding amounts of sugar, starch and fat. That is, whether the body was at rest or at work, it held its own just as well when alcohol formed a part of the diet as it did with a diet without alcohol.

Besides the six experiments reported in Bulletin No. 69, the final result of thirteen later ones are ready for publication. Of these eight were with a diet including alcohol. In some of them pure alcohol was given, in others it was in the form of whisky or brandy. The two alcohol experiments in Bulletin No. 69, and ten of the later ones, were with the same subject, a Swede by birth who had lived some time in this country and had been accustomed from his youth to the use of small quantities of alcohol. For a time previous to the period of the experiments he abstained from all use of alcohol, and during that period he used only what was needed for the experiment. The subject of the other three experiments was a native American who had always been a total abstainer. The results of all these later experiments are practically the same as those described in Bulletin No. 69. No difference has been found with different forms of alcohol or with different subjects.

In unauthorized statements regarding these experiments, which have been widely disseminated, much more has been claimed for them than they legitimately cover. The fact is that these are purely scientific experiments of limited scope, in which small quantities of alcohol were consumed for brief periods of time. They do not show the effects of habitual or excessive use of alcohol as a beverage. Their purpose and nature are such that they give no evidence regarding its pathological or toxic action.

They simply show that the limited quantity of alcohol that was given with other food material in the diet of healthy men for periods of a few days was almost completely burned in the body and yielded a certain amount of energy, and that this energy was actually utilized by the body, as is the energy which the body obtains from sugar, starch, fat and other ingredients of food. The clear evidence of this fact presented by these experiments is an important contribution to our knowledge concerning the nutritive action of alcohol.

These experiments mark only a single step toward the settlement of the broad questions involved in the use of alcoholic beverages. It is believed that the facts presented by them are reliable. But it should be remembered that the physiological action of alcohol involves much beside its nutritive effect. Its influence upon the circulatory and nervous functions is especially important. These matters are not treated in Professor Atwater's experiments.

SCIENTIFIC NOTES AND NEWS.

DR. SAMUEL W. STRATTON, associate professor of physics in the University of Chicago, has been appointed director of the Bureau of Weights and Measures, United States Coast and Geodetic Survey.

THE Rumford Committee of the American Academy of Arts and Sciences has appropriated the sum of $500, to Professor E. B. Frost of the Yerkes Observatory, to assist in the construction of a spectrograph especially designed for the measurement of stellar velocities in the line of sight.

PROFESSOR H. A. ROWLAND of the John's Hopkins University has been elected a foreign member of the Royal Society of Lombardy.

AT the November meeting of the American Academy of Arts and Sciences, Mr. Rudyard Kipling was elected a foreign honorary member in Class III., Section 4; and Sir Benjamin Baker of London, a foreign honorary member in Class I., Section 4; the latter in the place of the late Sir Henry Bessemer.

OWING to the press of his official duties as the Hydrographer of the United States Geological Survey, Mr. F. H. Newell has been obliged to resign the Secretaryship of the National Geographic Society (Washington, D. C.), an office which he has ably and zealously filled for the last two years. As a successor to Mr. Newell the Society has been fortunate in securing the acceptance of the office by Mr. Joseph Stanley-Browne, well known as the editor of the publications and proceedings of the Geological Society of America.

THE National Academy of Sciences is holding its annual autumn meeting at Columbia University as we go to press.

THE American Society of Naturalists will meet at Yale University, New Haven, on Wednesday, December 28th. The discussion in the afternoon will be on 'The Position that Universities should take in Regard to Investigation.'

PRELIMINARY announcements have also been prepared in regard to the meetings at New Haven of the American Psychological Association and of the Anthropological Section of the American Association for the Advancement of Science. The meetings will be on Wednesday, Thursday and Friday, December 27th, 28th and 29th. In the case of the Psychological Association the address of the president, Professor Dewey, will be given on the afternoon of Wednesday, followed by an informal discussion, while on Thursday morning there will be simultaneous sectional meetings for technical papers.

THE New York Zoological Park was formally opened to the public on the 8th inst. An address of welcome was made by Professor Henry F. Osborn, Chairman of the Executive Committee of the Zoological Society, which was responded to by Mr. Bird S. Coler, Controller of the City, and Mr. August Moebus, Park Commissioner of the Borough of the Bronx. Mr. Levi P. Morton, President of the Zoological Society, then formally declared the Park open. Twenty-five buildings and other installations for animals have been completed, and these now contain 850 animals.

M. BÉNARD, the French architect whose plans for the University of California are described in the present issue of SCIENCE, will leave Paris this month for Berkeley.

A DEPUTATION representing the committee of the proposed university for Birmingham has come to America to study American universities. The deputation includes Professor J. H. Poynting whose address as president of the Physical Section of the British Association was recently published in this JOURNAL.

PROFESSOR BATTISTA GRASSI has gone to Grosseto in order to complete his researches on the mosquitos concerned in the transmission of malarial infection.

THE Allahabad *Pioneer Mail*, as quoted in *Nature*, states that Mr. Douglas Freshfield has started from Darjeeling, with a party of friends and Alpine guides, to explore the glaciers and little-known passes of the Kanchenjunga range of the Himalayas.

MISS SUSIE P. NICHOLS, B.S., Cornell University, '98, and Fellow in Botany at Cornell University, 1898–99, has been appointed holder of the Woman's Table at the Zoological Station at Naples for the autumn of 1899 and spring, 1900. She is engaged upon certain studies in the embryology of plants and has already entered upon her work at Naples.

THE Medical Club of Philadelphia gave last week a reception to Professors Simon Flexner and John C. Clarke, who have this year severed their connection with the Johns Hopkins University to accept the chairs of pathology and gynecology at the University of Pennsylvania.

Nature states that copies in bronze of the medal presented to Sir G. G. Stokes at his jubilee can now be obtained from Messrs. Macmillan and Bowes, Cambridge, price fifteen shillings each.

THE death is announced of Dr. A. Ernst, Director of the National Museum, Carácas, Venezuela.

DR. EDWARD PETRI professor of geography and anthropology, in the University of St. Petersburg, has died at the age of forty-five years.

MR. OTTMAR MERGENTHALER, the inventor of the linotype machine, died at Baltimore on October 28th. The linotype substitute for type setting was first devised by him in 1880 and is now extensively used in newspaper offices.

THE death is announced of Mr. James Simpson, curator of the anatomical museum of the University of Edinburgh. He did much towards devising methods of mounting and displaying museum specimens and was the author of papers on various scientific subjects.

PROFESSOR ANDREW GRAY, Lord Kelvin's successor at the University of Glasgow, chose as the subject of his inaugural address 'The Interaction of Theory and Practical Applications in Physical Science.'

AT a special meeting of the Appalachian Mountain Club on November 22d, President T. C. Mendenhall, of Worcester Polytechnic Institute, will address the Club on the 'Controversy over Alaska.' President Mendenhall it will be remembered was one of the Commissioners on the Alaskan boundary.

THE lecture courses offered by the National Geographic Society in Washington, of which a preliminary program has already been published in SCIENCE, have been successfully inaugurated. The Society is at present in a most flourishing condition, numbering some 1,200 active and 1,200 corresponding, or non-resident members.

THE collection of birds secured by Professor Charles F. McClure and Mr. Sylvester, who were members of the recent Peary Relief Expedition, have been placed in the ornithological museum of Princeton University.

AT the Detroit Art Museum there is now a special exhibition of 28 paintings and 38 sketches by Mr. Frank Wilbert Stokes, made while on the Peary Relief Expedition of 1892, and the North Greenland Expedition of 1893–94. Most of those of scientific interest are of geographical or geological subjects.

THE Folk-Lore Society of Great Britain has offered to place on permanent deposit in the Museum of Archæology and Ethnology of Cambridge University the collection of objects illustrating the Folk-lore of Mexico, presented to the Society by Professor Starr of the University of Chicago, and the Antiquarian Committee has recommended that the offer be gratefully accepted. The collection consisting of upwards of 600 objects was made by Professor Starr in Mexico and was exhibited last June at a joint-

meeting of the Anthropological Institute and the Folk-Lore Society.

THE valuable library relating to American Indians collected by the eminent scholar, the late J. Hammond Trumbull, of Hartford, has been acquired by the Reference Library of Watkinson, Conn.

IT is stated in *Nature* that a British exploring expedition to Abyssinia has been arranged and will leave England at once. The members are Mr. James J. Harrison, Mr. Powell Cotton, Mr. W. Fitzhugh Whitehouse (of Newport, Rhode Island), and Mr. A. E. Butter. Mr. Donald Clarke will go as surveyor and geographer, and a taxidermist will accompany the party. The objects of the expedition are scientific and sporting, and it is expected that the journey will occupy about nine months.

THE first meeting of the new session of the Royal Geographical Society, was held on Monday, November 13th, when the President, Sir Clements Markham was expected to give a short opening address, to be followed by a paper by Mr. W. Rickmer Rickmers on his 'Travels in Bokhara,' illustrated by numerous lantern slides. The paper at the following meeting, November 27th, will be by Mr. Vaughan Cornish on 'Desert Sand Dunes.' At the December meeting Colonel Sir John Farquharson will probably give 'An Account of the Past Twelve Years' Work of the Ordinance Survey,' from the directorship of which he has recently retired. Other papers expected to be given during the session are: 'An Ascent of Mount Kenya,' by Mr. H. J. Mackinder; 'The Work of the Yermak Ice-Breaker in the Spitsbergen Seas,' by Admiral Makaroff; 'Travels in Central Asia,' by Captain H. H. P. Deasy; 'Travels in the Region of Lake Rudolf and the Sobat River,' by Captain Wellby; 'Travels in Abyssinia,' by Mr. H. Weld Blundell; 'Anthropogeography of British New Guinea,' by Professor Haddon.

THE Council of the Institution of Mechanical Engineers having decided to hold monthly general meetings during the ensuing session, the first of such gatherings took place on October 27th in the new buildings of the institution at Storey's-gate, St. James's Park. The London *Times* states that the chair was taken by the president, Sir W. H. White, and there was a full attendance of members. In opening the proceedings the president referred to the new arrangements made by the Council. He said that the alteration in their meetings had been decided upon only after the very fullest consideration. The feeling of the Council was that, having entered into their new house, they ought to make full use of it, and that a good beginning would be made by arranging monthly meetings during the winter. It has also been decided to hold their meetings on a single evening rather than, as had been the custom hitherto, on two three evenings in succession. By that means they hoped to get a better discussion. He could only appeal to the members to help in every way they could to make the new arrangement work successfully. They hoped to begin the graduates' meetings to-day. They looked to members to help them also in this new departure. A paper was then read by Mr. W. Ingham on 'The Incrustation of Pipes at the Torquay Waterworks.' He described the mechanical action of the scrapers constructed to remove the incrustation of the water pipes at Torquay, and the increase in the discharging power of the main affected by their use. Speaking generally he said it might be laid down with a fair approximation to the truth that well waters had not as great an action on pipes as those from upland gathering grounds, but where the water was soft the corrosive action would be greater. Filtered water had also a less corrosive power than unfiltered water. Much had been done to get a satisfactory coating to pipes, but there was still considerable room for improvement. It was hardly necessary to point out that a fortune awaited the man who could invent something that would withstand the action of soft waters. A discussion followed, and the meeting was adjourned until Friday, November 24th, when Lord Charles Beresford will read a paper on the opening for English engineers in China.

UNIVERSITY AND EDUCATIONAL NEWS.

As the result of a competition in which six invited forms of architects and three architectural firms in the city of St. Louis competed,

Messrs. Cope & Stewardson of Philadelphia were chosen as architects of the new buildings for Washington University. Mr. R. D. Andrews and Mr. R. Clipston Sturgis, of Boston, and Mr. Walter Cook, of New York, acted as advisers to the Board of Directors of the University in the competition. Messrs. Cope & Stewardson expect to have the plans for the new buildings completed by the first of March next; the work will then begin on the construction.

The family of the late John Simkins, who was congressman from Massachusetts and a graduate of Harvard University, have given $20,000 to the Lawrence Scientific School of the University. The fund will be used to equip the mining and metallurgical laboratories and a bronze memorial tablet will be placed in one of the rooms.

The will of the late Elizabeth Coles, leaving about $200,000 to found a Coles College in Newport, has been compromised, the City Council accepting $70,000 to endow a professorship of Natural Science in the Townsend Industrial School.

We are glad to learn that the decree of the United States Circuit Court dismissing the bill of review in the Garcelon case has been affirmed. This should give Bowdoin College the property bequeathed to it valued at about $400,000.

The chair of chemistry in the University of Toronto is vacant and will be filled as the result of applications addressed to the Minister of Education, Toronto, prior to January 1st, next. The salary is $2,500, rising by annual increments to $3,200. Further particulars may be obtained from the President of the University.

The Council of St. John's College, Cambridge, has elected as fellows of the College, Mr. J. J. Lister, university demonstrator of animal morphology, and Mr. A. C. Seward, F.R.S., university lecturer in botany, known for his publications on paleobotany.

Allen S. Whitney has been appointed professor of the science and art of teaching in the University of Michigan.

Paul I. Murrill, B.S. (State College of Kentucky), Ph.D. (Michigan), of Detroit, has been appointed to the Stearns fellowship in pharmaceutical research at the University of Michigan.

Colonel J. W. Ottley, formerly Inspector-General of Irrigation in India, has been appointed president of the Royal Engineer's College, at Cooper's Hill, England.

Dr. Berger has been appointed professor of geography at Leipzig, and Professor M. v. Lenhossek, of Tubingen, has been called to the professorship of anatomy at Budapesth.

Dr. W. Figdor has qualified as docent in plant anatomy and physiology at Vienna, and Dr. Pregl as docent in physiology at Gratz.

The Ithaca correspondent of the New York *Evening Post* reports the appointment of non-resident lecturers in mechanical engineering at Cornell University as follows: November 3d, J. J. Swann, on 'Liquid Air'; November 17th, W. B. Snow, on 'Mechanical Ventilating and Heating'; December 1st, Professor Houston, on 'Evolution of Electric Energy'; December 15th, William Kent, on 'Power Production'; January 12th, H. E. Longwell, on 'New Westinghouse Gas Engine'; January 19th, A. E. Kennelly, on 'Electrical Engineering Experiences'; January 26th, C. J. Field, on 'Safe Current Transmission'; February 23d, W. P. Potter, on 'Three-Phase Railway Work'; March 9th, P. T. Dodge, on 'Mechanical Type-Setting'; April 13th, Elihu Thomson, on 'Special Work in Electrical Engineering'; April 27th, E. W. Rice, Jr., on 'Dynamo and Engine Construction'; May 4th, W. M. Macfarland, on 'Recent Engineering Practice.'

The new University of London Hall for the Science of Political Economy, for which a site has been provided in the new street being formed by the London County Council in Clare-market, Strand, is to be proceeded with at once. The design by Mr. Maurice B. Adams, F.R.I.B.A., has been chosen by the trustees, of which body the Bishop of London and Mr. Sidney Webb, L.C.C., are active members. Mr. Passmore Edwards has given £10,000 towards the cost of the undertaking.

JOSEPH LOVERING.